MODELS HW/HWB 300, 399, 420, 520, 610, 670

GAS-FIRED COMMERCIAL COPPER BOILERS FOR HYDRONIC HEATING AND HOT WATER SUPPLY

UP-FLOW MODELS

• INSTALLATION • OPERATION • MAINTENANCE • LIMITED WARRANTY
• INDOOR ONLY

Burkay®

WARNING: If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

— **Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.**

— **WHAT TO DO IF YOU SMELL GAS**

- **Do not try to light any appliance.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.**
- **If you cannot reach your gas supplier, call the fire department.**

— **Installation and service must be performed by a qualified installer, service agency or the gas supplier.**

CAUTION

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A.O.Smith
Water Heaters

A DIVISION OF A.O. SMITH CORPORATION
MC BEE, SC SEATTLE, WA
STRATFORD, ONTARIO
VELDHOVEN, THE NETHERLANDS
www.hotwater.com

PLACE THESE INSTRUCTIONS ADJACENT TO BOILER AND NOTIFY OWNER TO KEEP FOR FUTURE REFERENCE

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PART NO. 211683-000 REV.02
SUPERSEDES PART NO'S, 210288-000 REV. 01 & 192356-000

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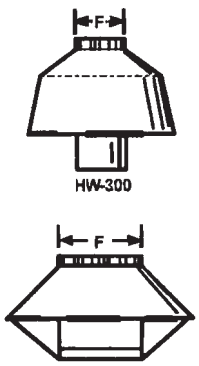
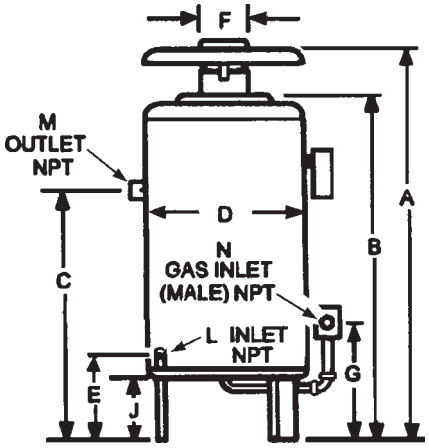
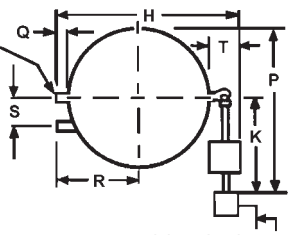
ROUGH-IN DIMENSIONS



HW/HWB-610
AND HW-670
NATURAL GAS ONLY



EXTRA OPENING
FOR THERMOMETER
AND RELIEF VALVE
HW/HWB-520, 610
AND HW--670



LOCATION OF MANUAL
MAIN SHUTOFF VALVE
OUTSIDE JACKET WHEN
CODE REQUIRE
(NOT SUPPLIED)

TABLE 1 **MODELS**

	DIMENSIONS IN INCHES	HWB/ HW-300	HWB/ HW-399	HWB/ HW-420	HWB/ HW-520	Prop. HWB/ HW-610/670	Nat. HWB/ HW-610/670
A	Overall height	65 (1651)	57-1/8 (1451)	57-1/8 (1451)	68-5/16 (1735)	67 (1702)	64-3/4 (1645)
B	Height to top of jacket	43-1/4 (1099)	45-1/8 (1146)	45-1/8 (1146)	56-1/4 (1429)	56-1/4 (1429)	56-1/4 (1429)
C	Floor to center line water inlet	36 (914)	38-3/4 (984)	38-3/4 (984)	46 (1168)	46 (1168)	46 (1168)
D	Diameter of jacket	25-1/4 (641)	27 (686)	27 (686)	27 (686)	27 (686)	27 (686)
E	Floor to center line water outlet	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)
F	Draft diverter outlet diameter	8 (203)	10 (254)	10 (254)	10 (254)	12 (305)	12 (305)
G	Floor to center line gas inlet	16-1/2 (419)	16-3/4 (425)	16-3/4 (425)	18 (457)	18 (457)	18 (457)
H	Overall depth	29-5/8 (753)	31-1/2 (800)	31-1/2 (800)	36-1/2 (927)	36-1/2 (927)	36-1/2 (927)
J	Support height	9 (229)	9 (229)	9 (229)	9(229)	9 (229)	9 (229)
K	Width of control string (approx.)	14 (356)	14 (356)	14 (356)	11(279)	11 (279)	11 (279)
L	Pipe size of water inlet (NPT)	1-1/4	1-1/2	1-1/2	2	2	2
M	Pipe size of water outlet(NPT)	1-1/4	1-1/2	1-1/2	2	2	2
N	Pipe size of gas inlet (NPT)	3/4	1	1	1	1	1
P	Control string plus 1/2 jacket dia. (approx.)	26-5/8 (676)	27-1/2(699)	27-1/2 (699)	24-1/2 (622)	24-1/2 (622)	24-1/2 (622)
Q	Water outlet to jacket	1 (25)	1 (25)	1 (25)	3-1/2 (89)	3-1/2 (89)	3-1/2 (89)
R	Water inlet casting to center line of jacket	10-1/8 (257)	11-1/4 (286)	11-1/4 (286)	12 (305)	12 (305)	12 (305)
S	Horizontal length between water inlet and outlet	5-3/8 (137)	5-1/2 (140)	5-1/2 (140)	5-3/4 (146)	5-3/4 (146)	5-3/4 (146)
T	Control string from jacket	5 (127)	5 (127)	5 (127)	7 (178)	7 (178)	7 (178)
	Approx. shipping weight lbs. (Kilograms)	240 (109)	291 (132)	291 (132)	361 (164)	361 (164)	361 (164)

NOTE: All dimensions in inches (millimeters) except pipe size which is NPT.

TABLE 2, SPECIFICATIONS - CANADIAN MODELS ONLY

Model	Type of Gas	Maximum BTUH(KW)	Maximum I.A.S. BTUH(KW)	Maximum Heat Loss Load	Max. Heat Transfer Surface Area (Sq. Ft.)	Max. Heat Transfer Surface Area (Sq. Ft.)
HWB-300	Natural & Propane	300,000 (88)	247,200 (72)	210,120 (62)	1,410 (.41)	1,051 (.31)
HWB-399	Natural & Propane	399,000 (116)	322,790 (95)	274,371 (80)	1,829 (.54)	1,372 (.40)
HWB-420	Natural & Propane	420,000 (123)	344,400 (101)	292,740 (86)	1.952 (57)	1,464 (.43)
HWB-520	Natural & Propane	520,000 (152)	429,000 (126)	364,650 (107)	2,431 (.71)	1,823 (.53)
HWB-610	Natural	610,000 (179)	502,600 (147)	427,210 (125)	2,848 (.83)	2,136 (.61)
HWB-610	Propane	610,000 (179)	488,000 (143)	414,800 (121)	2,765 (.81)	2,074 (.61)

Ratings shown are for current modern heating system design. Where A.O. Smith boilers are connected to heavy, cast iron radiator systems or where unusual pick-up or large size piping conditions exist, reduce ratings by 10%.

NOTE: To compensate for the effects of high altitude areas above 2000 feet, the input, output and heating load ratings should be reduced approximately 4% for each 1000 feet above sea level.

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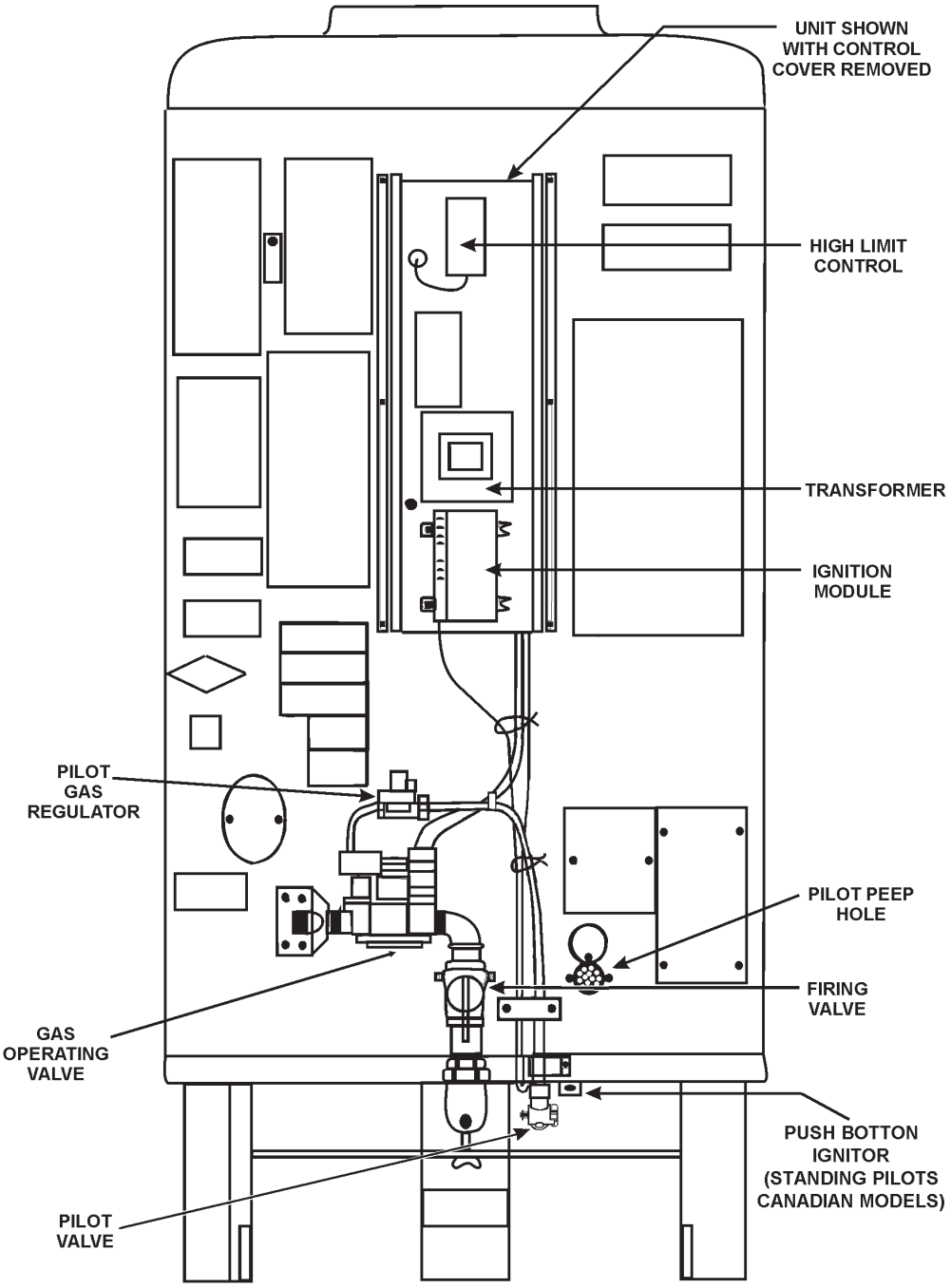
TABLE 3, RECOVERY CAPACITIES - CANADIAN MODELS ONLY

Model	Input (Btu/Hr.)	Temp. (C) Rise (F)	11 20	17 30	22 40	26 50	33 60	39 70	44 80	50 90	56 100	61 110	67 120	72 130	78 140
HW-300	300,000	LPH	5,505	3,670	2,753	2,202	1,835	1,573	1,376	1,223	1,001	1,001	918	847	786
		GPH	1,455	970	727	582	485	416	364	323	291	264	242	224	208
HW-399	399,000	LPH	7,322	4,882	3,661	2,929	2,441	2,092	1,831	1,627	1,464	1,331	1,220	1,127	1,046
		GPH	1,935	1,290	967	774	645	553	484	430	387	352	322	298	276
HW-420	420,000	LPH	7,708	5,138	3,854	3,083	2,569	2,202	1,927	1,713	1,542	1,401	1,285	1,186	1,101
		GPH	2,036	1,358	1,018	815	679	582	509	453	407	370	339	313	291
HW-520	520,000	LPH	9,543	6,362	4,771	3,817	3,181	2,727	2,386	2,121	1,909	1,735	1,590	1,468	1,363
		GPH	2,521	1,681	1,261	1,008	840	720	630	560	504	458	420	388	360
HW-610	610,000	LPH	11,194	7,463	5,597	4,478	3,731	3,198	2,799	2,488	2,239	2,035	1,866	1,722	1,599
		GPH	2,958	1,972	1,479	1,183	986	845	739	657	592	538	493	455	423



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FOREWORD

CAUTION

TEXT PRINTED OR OUTLINED IN RED CONTAINS INFORMATION RELATIVE TO YOUR SAFETY. PLEASE READ THOROUGHLY BEFORE USING APPLIANCE.

Detailed installation diagrams are in this manual. These diagrams will serve to provide the installer with a reference for the materials and method of piping suggested. IT IS NECESSARY THAT ALL WATER AND GAS PIPING AND THE ELECTRICAL WIRING BE INSTALLED AND CONNECTED AS SHOWN IN THE DIAGRAMS.

CHECK THE DIAGRAMS THOROUGHLY BEFORE STARTING INSTALLATION TO AVOID POSSIBLE ERRORS AND TO MINIMIZE TIME AND MATERIALS COST.

This design complies with the latest edition of ANSI Z21.13. CSA 4.9 low-pressure boiler.

Particular attention should be given to the installation of thermometers at the locations indicated in the diagrams as these are necessary for checking the operation of the boiler.

MAKE SURE THE GAS ON WHICH THE BOILER WILL OPERATE IS THE SAME AS THAT SPECIFIED ON THE UNIT RATING PLATE.

The boiler installation must conform to these instructions and the requirements of the local authority having jurisdiction.

Where required by authority having jurisdiction, the installation must conform to the Standard for *Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1.*

In absence of local code requirements, the boiler installation must conform to the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CSA B-149.1-00 Installation Codes.

These manuals can be purchased from the CSA International, 8501 East Pleasant Valley Road, Cleveland, OH 44131 or 178 Rexdale Boulevard, Toronto, Ontario Canada M9W1R3.

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INSTALLATION INSTRUCTIONS

REQUIRED ABILITY

INSTALLATION OR SERVICE OF THIS BOILER REQUIRES ABILITY EQUIVALENT TO THAT OF A LICENSED TRADESMAN IN THE FIELD INVOLVED. PLUMBING, AIR SUPPLY, VENTING, GAS SUPPLY AND ELECTRICAL WORK ARE REQUIRED.

INSTALLATION AS BOILER REPLACEMENT

Installation as boiler replacement on an old system with large water volume may experience condensation within the boiler on cold starts. This condensing of water vapor in the combustion area can be prevented if a portion of the system water flow is diverted past the boiler to cause an increase in boiler temperature rise.

With old systems where water temperature can be expected to drop appreciably due to long standby periods, a bypass pipe of at least 1" size with a balancing cock should be installed between the boiler inlet and outlet. When the system first starts, the valve should be slowly opened until the condensing ceases. This adjustment remains at a permanent setting to establish required temperature rise across the boiler.

The equipment shall be installed in accordance with those installation regulations in force in the local area where the installation is to be made. These shall be carefully followed in all cases. Authorities having jurisdiction shall be consulted before installations are made.

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LOCATION

When installing the boiler, consideration must be given to proper location. Location selected should be as close to the stack or chimney as practicable with adequate air supply and as centralized with the piping system as possible. This location should also be such that the gas ignition system components are protected from water (dripping, spraying, etc.) during appliance operation and service (circulator replacement, control replacement, etc.).

THE BOILER MUST NOT BE INSTALLED ON CARPETING.

THE BOILER SHOULD NOT BE LOCATED IN AN AREA WHERE IT WILL BE SUBJECT TO FREEZING.

LOCATE IT NEAR A FLOOR DRAIN. THE BOILER SHOULD BE LOCATED IN AN AREA WHERE LEAKAGE FROM THE BOILER OR CONNECTIONS WILL NOT RESULT IN DAMAGE TO THE ADJACENT AREA OR TO LOWER FLOORS OF THE STRUCTURE.

WHEN SUCH LOCATIONS CANNOT BE AVOIDED, A SUITABLE DRAIN PAN SHOULD BE INSTALLED UNDER THE BOILER. Such pans should be fabricated with sides at least 60mm (2-1/2") deep, with length and width at least 50mm (2") greater than the diameter of the boiler and must be piped to an adequate drain. The pan must not restrict combustion air flow.

⚠ WARNING

KEEPING BOILER AREA CLEAR AND FREE FROM COMBUSTIBLE MATERIALS, GASOLINE AND OTHER FLAMMABLE VAPORS AND LIQUIDS.

⚠ WARNING

THERE IS A RISK IN USING FUEL BURNING APPLIANCES SUCH AS BOILERS IN ROOMS OR AREAS WHERE GASOLINE, OTHER FLAMMABLE LIQUIDS OR ENGINE DRIVEN EQUIPMENT OR VEHICLES ARE STORED, OPERATED OR REPAIRED. FLAMMABLE VAPORS ARE HEAVY AND TRAVEL ALONG THE FLOOR AND MAY BE IGNITED BY THE IGNITER OR MAIN BURNER FLAMES CAUSING FIRE OR EXPLOSION. SOME LOCAL CODES PERMIT OPERATION OF GAS APPLIANCES IF INSTALLED 18 INCHES OR MORE ABOVE THE FLOOR. THIS MAY REDUCE THE RISK IF LOCATION IN SUCH AN AREA CANNOT BE AVOIDED.

⚠ WARNING

FLAMMABLE ITEMS, PRESSURIZED CONTAINERS OR ANY OTHER POTENTIAL FIRE HAZARDOUS ARTICLES MUST NEVER BE PLACED ON OR ADJACENT TO THE BOILER. OPEN CONTAINERS OF FLAMMABLE MATERIAL MUST NOT BE STORED OR USED IN THE SAME ROOM WITH THE BOILER.

A hot water boiler installed above radiation level or as required by the authority having jurisdiction, must be provided with a low water cutoff device at the time of boiler installation.

AIR REQUIREMENTS

Provisions for combustion and ventilation air in accordance with section 5.3, Air for Combustion and Ventilation, of the National Fuel Gas Code, ANSI Z223.1, or sections 7.2, 7.3, or 7.4 of CAN/CSA B149.1-00, Installation Codes, or applicable provisions of the local building codes.

Provisions for vent, bleed and gas relief lines (when applicable).

Keep appliance area free of combustible or flammable liquids. Do not obstruct the flow of combustion or ventilating air.

⚠ WARNING

FOR SAFE OPERATION PROVIDE ADEQUATE AIR FOR COMBUSTION AND VENTILATION. AN INSUFFICIENT SUPPLY OF AIR WILL CAUSE RECIRCULATION OF COMBUSTION PRODUCTS RESULTING IN AIR CONTAMINATION THAT MAY BE HAZARDOUS TO LIFE. SUCH A CONDITION OFTEN WILL RESULT IN A YELLOW, LUMINOUS BURNER FLAME, CAUSING CARBONING OR SOOTING OF THE COMBUSTION CHAMBER, BURNERS AND FLUE TUBES AND CREATES A RISK OF ASPHYXIATION.

UNCONFINED SPACE

In buildings of conventional frame, brick or stone construction, unconfined spaces may provide adequate air for combustion, and draft hood dilution.

If the unconfined space is within a building of tight construction (buildings using the following construction: weather stripping, heavy insulation, caulking, vapor barrier, etc.) air for combustion, ventilation, and draft hood dilution must be obtained from outdoors or spaces freely communicating with the outdoors. The installation instructions for confined spaces in tightly constructed buildings must be followed to ensure adequate air supply.

CONFINED SPACE

(a) U. S. INSTALLATIONS

When drawing combustion and dilution air from inside a conventionally constructed building to a confined space, such a space shall be provided with two permanent openings, ONE WITHIN 12 INCHES OF THE ENCLOSURE TOP AND ONE WITHIN 12 INCHES OF THE ENCLOSURE BOTTOM. Each opening shall have a free area of at least one square inch per 1000 Btuh of the total input of all appliances in the enclosure, but not less than 100 square inches.

If the confined space is within a building of tight construction, air for combustion, ventilation, and draft hood dilution must be obtained from outdoors. When directly communicating with the outdoors or communicating with the outdoors through vertical ducts, two permanent openings, located in the above manner, shall be provided. Each opening shall have a free area of not less than one square inch per 4000 Btuh of the total input of all appliances in the enclosure. If horizontal ducts are used, each opening shall have a free area of not less than one square inch per 2000 Btuh of the total input of all appliances in the enclosure.

(b) CANADIAN INSTALLATIONS

Ventilation of the space occupied by the boiler(s) shall be provided by an opening for ventilation air at the highest practical point communicating with outdoors. The total cross-sectional area shall be at least 10% of the area of the combustion air opening but in no case shall the cross-sectional area be less than 10 square inches (6500 mm^2)

In additional to the above, there shall be permanent air supply opening(s) having a cross-sectional area of not less than 1 square inch per 7,000 BTUH (310 mm^2/KW) up to and including 1,000,000 BTUH plus 1 square inch per 14,000 BTU in excess of 1,000,000 BTUH. This opening(s) shall be located at, or ducted to, a point neither more than 18" (450 mm) nor less than 6 inches (150 mm) above the floor level.

Where power vented equipment is used in the same room as the boiler, sufficient air openings must be supplied.

UNDERSIZED OPENINGS MAY RESULT IN INSUFFICIENT AIR FOR COMBUSTION.

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Where an exhaust fan is installed in the same room with a boiler, sufficient openings for air must be provided in the walls.

UNDERSIZED OPENINGS WILL CAUSE AIR TO BE DRAWN INTO THE ROOM THROUGH THE CHIMNEY, CAUSING POOR COMBUSTION. SOOTING MAY RESULT WITH AN INCREASED RISK OF ASPHYXIATION.

CHEMICAL VAPOR CORROSION

WARNING

CORROSION OF THE FLUEWAYS AND VENT SYSTEM MAY OCCUR IF AIR FOR COMBUSTION CONTAINS CERTAIN CHEMICAL VAPORS WHICH BREAK DOWN INTO ACIDS AT HIGH TEMPERATURE. SUCH CORROSION MAY RESULT IN FAILURE AND RISK OF ASPHYXIATION.

Water boiler corrosion and component failure can be caused by the heating and breakdown of airborne chemical vapors. Spray can propellants, cleaning solvents, refrigerator and air conditioning refrigerants, swimming pool chemicals, calcium and sodium chloride, waxes, and process chemicals are typical compounds which are corrosive. These materials are corrosive at very low concentration levels with little or no odor to reveal their presence. Products of this sort must not be stored near the boiler. Also, air which is brought in contact with the water boiler should not contain any of these chemicals. If necessary, uncontaminated air should be obtained from remote or outside sources.

INSTALLATION CLEARANCES

These boilers are approved for installation on combustible flooring in an alcove with minimum clearance to combustibles of:

TABLE 4

	HWB/HW 300	HWB/HW 399	HWB/HW 420	HWB/HW 520	HWB/HW 610 & 670
TOP	28" (711.2)	32" (812.8)	24" (609.6)	24" (609.6)	24" (609.6)
SIDES	6" (152.4)	6" (152.4)	24" (609.6)	24" (609.6)	24" (609.6)
REAR	6" (152.4)	6" (152.4)	24" (609.6)	24" (609.6)	24" (609.6)
VENT	6" (152.4)	6" (152.4)	6" (152.4)	6" (152.4)	6" (152.4)

Two inch (50.8mm) clearance is allowable from combustible construction for hot water pipes.

Sufficient area should be provided at the front and rear of the unit for proper servicing. Clearances of 24 inches (609.4mm) in the rear and 48 inches (1,219mm) in the front are required by code. In a utility room installation, the door shall be wide enough to allow the boiler to enter or to permit the replacement of another appliance such as a water heater.

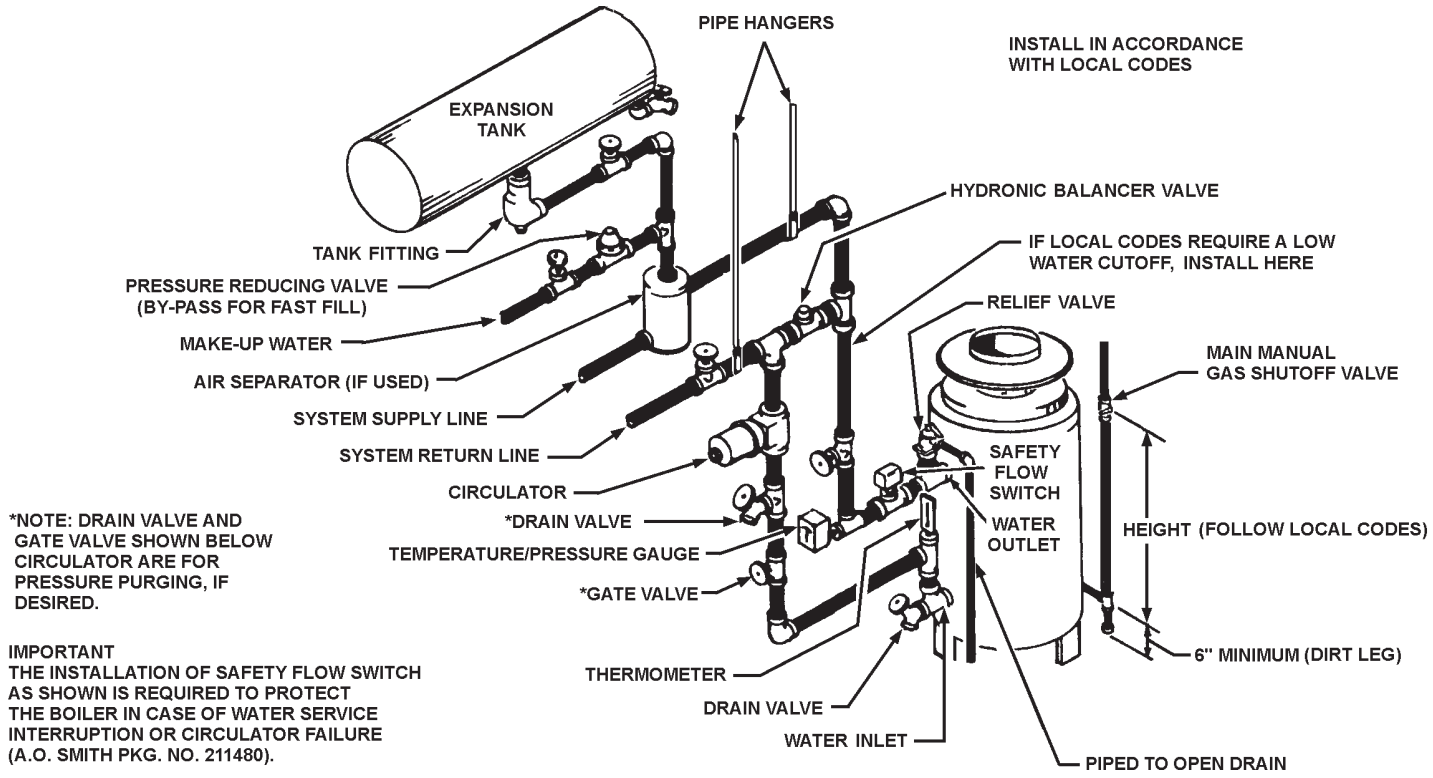
LEVELLING

Each unit should be checked after installation to be certain that it is level.

If the unit is not level, insert metal shims under the legs of the unit to correct this condition.

SYSTEM CONNECTIONS

The system installation must conform to these instructions and to the requirements of the local code authority having jurisdiction. Good practice requires that all heavy piping be supported.


PIPE HANGERS
INSTALL IN ACCORDANCE WITH LOCAL CODES
EXPANSION TANK
HYDRONIC BALANCER VALVE
IF LOCAL CODES REQUIRE A LOW WATER CUTOFF, INSTALL HERE
TANK FITTING
PRESSURE REDUCING VALVE (BY-PASS FOR FAST FILL)
RELIEF VALVE
MAKE-UP WATER
MAIN MANUAL GAS SHUTOFF VALVE
AIR SEPARATOR (IF USED)
SYSTEM SUPPLY LINE
SYSTEM RETURN LINE
SAFETY FLOW SWITCH
CIRCULATOR
*DRAIN VALVE
WATER OUTLET
HEIGHT (FOLLOW LOCAL CODES)
TEMPERATURE/PRESSURE GAUGE
*GATE VALVE
6" MINIMUM (DIRT LEG)
THERMOMETER
DRAIN VALVE
WATER INLET
PIPED TO OPEN DRAIN
*NOTE: DRAIN VALVE AND GATE VALVE SHOWN BELOW CIRCULATOR ARE FOR PRESSURE PURGING, IF DESIRED.
IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE (A.O. SMITH PKG. NO. 211480).

A TYPICAL BOILER INSTALLATION
FIGURE 1

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1. CONVENTIONAL INSTALLATIONS

All modern hydronic type boilers are exceptionally fast heating units. The low water volumes in relation to firing rates require special attention to water flow rates for smooth, efficient operation. These considerations for the A. O. Smith copper heat exchanger boilers are covered below.

Conventional 10°C (20°F) drop in systems for a fully loaded boiler will maintain the following approximate flow rates:

U.S. MODELS	CANADIAN MODELS	LPM	GPM
HW-300	HWB-300	87	23
HW-399	HWB-399	114	30
HW-420	HWB-420	132	35
HW-520	HWB-520	148	39
HW-670	HWB-610	175	46

Figure 1 shows a typical installation of the boiler with pipe sizing and circulator selected by the installer to provide adequate water flow whenever the boiler is firing.

In a system with several large zones of which any might be smaller than approximately 1/3 of the system should include a hydronic balancer as shown in fig. 1. The balancer connects between the system supply and the return line before the circulator inlet. Adjustment of the balancing cock should permit adequate boiler flow rate when only the smallest zone is in operation.

Attention should be given to balancing inputs and water flow rates where wide variations of system flow rates can occur.

The recommended minimum flow rates that will result in approximately 30°C (50°F) temperature rise across the boiler are as follows:

U.S. MODELS	CANADIAN MODELS	LPM	GPM
HW-300	HWB-300	34	9
HW-399	HWB-399	45	12
HW-420	HWB-420	53	14
HW-520	HWB-520	61	16
HW-610	HWB-610	69	18
HW-670		76	20

If system flow rate is unknown, or if zoning creates extreme variations in flow rates, the boiler should be installed as shown in fig. 2 for A. O. Smith LINEAR-TEMP installations.

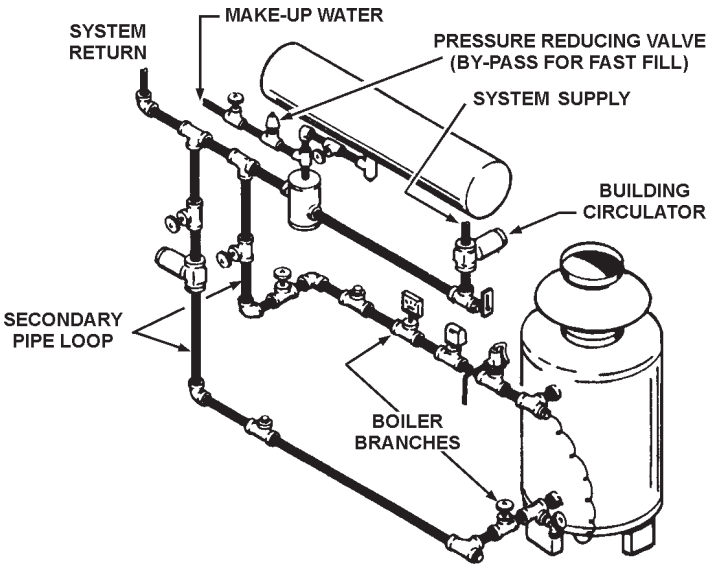
2. LINEAR-TEMP INSTALLATIONS

A. New Installations

A. O. Smith LINEAR-TEMP systems have been designed to provide efficient, trouble-free operation of the boiler sizes covered in this manual with any of the following conditions:

a. Unknown system flow rate
b. Varying flow rate as with zoned systems
c. Multiple boiler installations

Figure 2 shows piping and accessory arrangement for a boiler pumped independent of the primary system mains. Pipe sizing and boiler loop pump selection data are shown in Table 5 for several different temperature rises across the boilers.



ONE BOILER INSTALLED INDEPENDENT OF THE PRIMARY SYSTEM FIGURE 2

Total heating requirements for the building can be supplied by a series of boiler loops all connecting to a common pipe joining the system supply and return mains. The supply and return branches of each boiler loop must join the common pipe only a short nipple length apart. The different sets of branches should be installed reasonably close together, but not necessarily to the short nipple length as required for the supply and return of each set. These branches may be made with tees or with welded connections.

The installer is reminded that the total boiler flow rates need not match the system flow rate.

TABLE 5
PUMP AND PIPE SIZING DATA
(PIPING FROM TEES IN MAIN TO BOILER BRANCHES)

Quantity and Model		Temp.		*Pump	Pipe
U.S	Canadian	Rise°C (°F)	G.P.M.	Size	Size
HW-300	1 HWB-300	10 (20)	23	1-1/2"PR	2"
		15 (30)	15	150	1-1/2"
		15 (30)	15	125	1-1/4"
		20 (40)	11	100	1"
HW-399	1 HWB-399	10 (20)	30	60-13	2"
		15 (30)	20	1-1/2"HV	1-1/2"
		20 (40)	15	150	1-1/2"
		20 (40)	15	125	1-1/4"
HW-420	1 HWB-420	10 (20)	32	60-13	2"
		15 (30)	21	1-1/2"HV	1-1/2"
		20 (40)	16	150	1-1/2"
		20 (40)	16	125	1-1/4"
HW-520	1 HWB-520	10 (20)	39	2-1/2"	2-1/2"
		10 (20)	26	1-1/2"HV	2"
		17 (35)	23	1-1/2"HV	1-1/2"
		20 (40)	20	150	1-1/2"
HW-670	1 HWB-610	10 (20)	51	60-13	3"
		15 (30)	34	2-1/2"	2-1/2"
		17 (35)	29	2"	2"
		20 (40)	25	1-1/2"HV	1-1/2"

NOTE: Pipe loop sizes and pump selections based on 50 equivalent feet of pipe and fittings.

*All pump sizes listed are B & G model numbers.

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NO.	SUGGESTED ITEMS FOR INSTALLATION	
1	Short pipe nipple and pair of boiler loop tees in piping between system supply and return. One set per each group of boilers	
2	Boiler pipe loop. See piping sizing data above.	
3	Boiler circulator. See pump sizing data above.	
4	Thermometer.	
5	Theraltimeter.	
6	Plug cock to control flow rate.	
7	Safety flow switches. For interlock with other systems or instead of low water cutoff.	
8	Relief valve.	
9	With one -300, -399 or -420 item 9 is - sensing element of remote control. With a group of -300's, -399's or -420's, item 9 is - for 1st. boiler, the sensing element as above. For additional boilers, install a 2nd. limit control if required by local codes. With any -520, -610 or 670 boilers, install 2nd. limit control here if required by local code.	
	BOILER INLET - OUTLET SIZES	
10	HWB-300 - 1-1/4", HWB-399 - 1-1/2", HWB-420-1-1/2", HWB-520 & HWB-610 - 2". Canadian Models	
10	HW-300 - 1-1/4", HW-399 - 1-1/2", HW-420-1-1/2", HW-520 & HW-670 - 2". U.S. Models	
	MINIMUM BRANCH SIZES TO BOILERS	
11	HWB-300 - 1-1/4" HWB-399 - 1-1/2" HWB-420 - 1-1/2"	HWB-520, 610 (Single boiler per pump) 2" Canadian Models
11	HW-300 - 1-1/4" HW-399 - 1-1/2" HW-420 - 1-1/2"	HW-520, 670 (Single boiler per pump) 2" U.S. Models
12	Flow control valve. Required only if flow rate of system primary is excessive for size of boiler branch tees or if chilled water main is above boilers.	
13	System supply temperature thermometer.	
14	Boiler headers for three (3) boilers can be larger than pipe loop, if desired, to aid in balancing.	

The system flow rate is selected to give the desired system temperature drop - depending on the design criteria.

The boiler generator flow rates, on the other hand, should be selected to give the temperature rise through the generator that is both economical and offers the best generator efficiency.

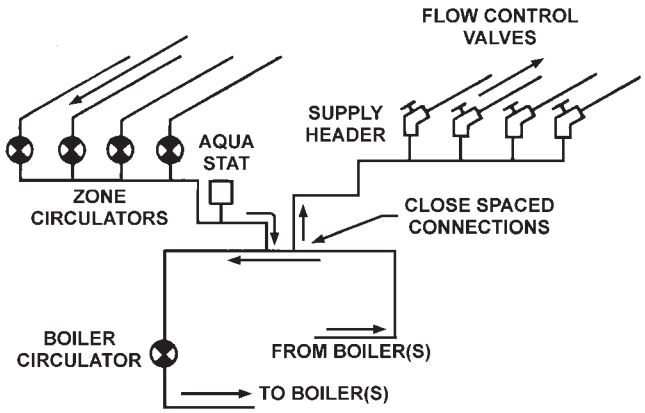
The boiler temperature rise is normally between 10°C and 20°C (20°F and 40°F). The system temperature that will be introduced to the boiler (inlet temperature) plus the selected boiler temperature rise selected from PUMP AND PIPE SIZING DATA should not exceed the high limit control setting of 115°C (240°F).

There should be a relation of the minimum system load to the size boiler selected as the first firing or base boiler. This will stabilize operation during minimum load periods.

B. Commercial Boiler Replacements

Application of LINEAR-TEMP® to a commercial boiler replacement with an old multiple pump installation is an excellent way to modernize the system. The A. O. Smith boiler(s) should be installed on a pipe loop with a separate circulating pump selected from PUMP AND PIPE SIZING DATA TABLE.

Figure 3 shows a line drawing of how the system headers should be connected to the pipe loop installed with the replacement boiler(s). Make-up water connections and accessories are not shown.



SCHEMATIC OF THE LINEAR-TEMP® SYSTEM
FIGURE 3

Supply and return headers of the old system should be connected to the boiler loop with a pair of tees set close together. The boiler loop pump and the boiler(s) should be wired to operate only when any of the system pumps are in operation. The number of zone pumps that may be in operation at any particular time will take their required flow rate out from the first tee in the boiler piping. This water will be circulated through the proper branches from the supply header to the zones calling for heat. The water will be brought back to the return header and then into the second tee in the boiler pipe loop. There will be no conflict between the boiler pump and the zone pumps when the two tees in the boiler loop are placed close together.

Normal use of flow control valves is required to prevent cross circulation of zones as with any multiple pump system. Flow control is not required on boiler circuit.

Attention should be given to balancing gas inputs and water flow rates. Large systems with multiple boilers should include main water temperature control (with or without outdoor reset) to stage the boilers on and off in relation to the load on the system.

3. WATER SUPPLY LINE

These boilers can be used ONLY in a forced circulation hot water heating system. Since most forced circulation systems will be of the closed type, install the water supply line as shown on piping diagrams, fig. 1 or 2.

Fast filling of large pipe, old radiator installations and pressure purging of series loop systems (where high pressures are not available) requires bypassing of the pressure reducing valve. Generally, pressure purging is not possible with a well pump system. High point air venting is essential.

If the system is of the open type, a pressure reducing valve will not be required as the water supply to the system will be controlled by a manually operated valve. An overhead surge tank is required.

4. EXPANSION TANK

⚠ CAUTION

A closed system will exist if a check valve (without bypass), pressure reducing valve (without bypass), or a water meter (without bypass) is installed in the cold water line between the water heater and street main (or well).

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Excessive pressure may develop causing premature tank failure or intermittent relief valve operation. This is not a warranty failure. An expansion tank or a similar device may be required in the inlet supply line between the appliance and the meter or valve to compensate for the thermal expansion of water under supply pressure, see figure 1.

An air separator as shown in the piping diagrams is recommended especially for modern commercial hydronic systems.

5. VENT VALVES

It is recommended that automatic, loose key or screwdriver type vent valves be installed at each convector or radiator.

6. MANIFOLD HEADERS

Split systems with individual supply and return lines from the boiler room should normally have this piping connected to supply and return manifold headers near the boiler. To achieve good water distribution with maximum pressure drop for several circuits, manifolds of at least 2-1/2" (64mm) diameter are suggested on HWB/HW-399, HWB/HW-420, HWB/HW-520, HWB/HW-610 and HW-670 units. HWB/HW-300 units should have 1-1/2" (38mm) diameter manifolds.

The circuits should be spaced on the header at a minimum of 3" (76mm) center to center. Install a balancing cock in each return line.

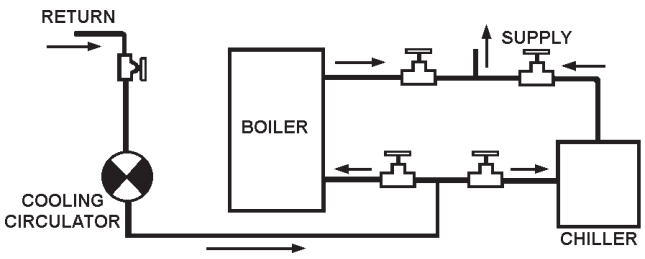
Manifold headers are recommended for split systems with or without zone valves and also those installations with zone circulators. If the system is to be split at remote points, good practice requires special attention be given to main pipe sizing to allow balancing of water flow.

The boiler piping system of a hot water boiler connected to heating coils located in air handling units where they may be exposed to refrigerated air circulation must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

7. COOLING PIPING

When the boiler is used in conjunction with a refrigeration system it must be installed so that the chilled medium is piped in parallel with the boiler with appropriate valves to prevent the chilled medium from entering the boiler, fig. 4.

Water temperature in the heating system must be reduced to less than 100^{0}F (38°C) before cooling system is started, or damage to the chiller unit may occur.

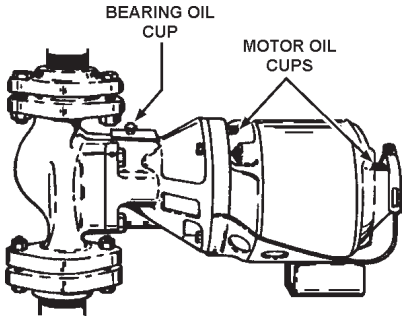


SCHEMATIC SHOWING PROPER PIPING ISOLATION OF THE BOILER FROM THE CHILLER
FIGURE 4

If the boiler is connected to chilled water piping or its heating coils are exposed to refrigerated air, the boiler piping system must be equipped with flow valves or other automatic means to prevent gravity circulation through the boiler during the cooling cycle.

8. CIRCULATING PUMP

CONSTANT CIRCULATING PUMP OPERATION OF THE BOILER VOIDS THE WARRANTY. Constant water flow through the unit will "wash" away the copper's natural protective coating. This is called velocity erosion. This erosion is not as great a problem when intermittent circulating operation is used per the recommended installation procedure. Constant circulation of water through the building's system main is permissible as long as the water does not constantly flow through the boiler. Only all bronze or stainless steel circulators are to be used with the unit when it is installed in HOT WATER SUPPLY SYSTEMS.



A TYPICAL CIRCULATING PUMP
FIGURE 5

Although each circulator that requires oiling is oiled and operated by the manufacturer, IT MUST BE OILED AGAIN BEFORE OPERATED. Oil the three oil cups (2 on the motor, 1 on the pump) as instructed on the oil tube supplied with the unit, fig 5.

Thereafter, during the heating season, lubricate the three oil cups at least once every four months. Combination heating-cooling systems should be lubricated every four months year 'round.

Use 2 or 3 teaspoonsful in bearing oil cups, fig. 5, and 10 or 12 drops in the motor oil cups. Use No. 20 non-detergent motor oil.

Follow the same oiling procedure if a replacement circulator is installed into the system.

GAS CONNECTIONS

⚠ WARNING

THIS BOILER IS NOT INTENDED TO OPERATE AT GAS SUPPLY PRESSURE OTHER THAN SHOWN ON THE RATING PLATE. EXPOSURE TO HIGHER GAS SUPPLY PRESSURE MAY CAUSE DAMAGE TO GAS VALVES WHICH CAN RESULT IN FIRE OR EXPLOSION. IF OVERPRESSURE HAS OCCURRED SUCH AS THROUGH IMPROPER TESTING OF GAS LINES OR EMERGENCY MALFUNCTION OF THE SUPPLY SYSTEM, THE GAS VALVES MUST BE CHECKED FOR SAFE OPERATION. MAKE SURE THAT THE OUTSIDE VENTS ON THE SUPPLY REGULATORS AND THE SAFETY VENT VALVES ARE PROTECTED AGAINST BLOCKAGE. THESE ARE PARTS OF THE GAS SUPPLY SYSTEM, NOT THE BOILER. VENT BLOCKAGE MAY OCCUR DURING ICE BUILD-UP OR SNOW STORMS.

WHEN LOCAL CODES REQUIRE A MAIN MANUAL SHUTOFF VALVE OUTSIDE THE BOILER JACKET, A SUITABLE MAIN MANUAL SHUTOFF VALVE MUST BE INSTALLED IN A LOCATION COMPLYING WITH THOSE CODES.

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IT IS IMPORTANT TO GUARD AGAINST GAS VALVE FOULING FROM CONTAMINANTS IN THE GAS WAYS. SUCH FOULING MAY CAUSE IMPROPER OPERATION, FIRE OR EXPLOSION.

IF COPPER SUPPLY LINES ARE USED THEY MUST BE CERTIFIED FOR GAS SERVICE.

BEFORE ATTACHING THE GAS LINE BE SURE THAT ALL GAS PIPE IS CLEAN ON THE INSIDE.

TO TRAP ANY DIRT OR FOREIGN MATERIAL IN THE GAS SUPPLY LINE, A DIRT LEG (SOMETIMES CALLED DRIP LEG or sediment trap) MUST BE INCORPORATED IN THE PIPING, SEE FIG. 1. The dirt leg must be readily accessible and not subject to freezing conditions. INSTALL IN ACCORDANCE WITH RECOMMENDATIONS OF SERVING GAS SUPPLIERS. (Refer to National Fuel Gas Code, ANSI Z223.1 and/or CAN/CSA-B 149.1-00 Installation Codes.

To prevent damage, care must be taken not to apply too much torque when attaching gas supply pipe to gas valve gas inlet.

Fittings and unions in the gas line must be metal to metal type.

Apply joint compounds (pipe dope) sparingly and only to the male threads of pipe joints. Do not apply compound to the first two threads. Use compounds resistant to the action of liquefied petroleum gases.

THE BOILER AND ITS GAS CONNECTIONS MUST BE LEAK TESTED BEFORE PLACING THE BOILER IN OPERATION. Use soap and water solution or other material acceptable for the purpose in locating gas leaks. DO NOT USE MATCHES, CANDLES, FLAME OR OTHER SOURCES OF IGNITION FOR THIS PURPOSE.

DISCONNECT THE BOILER AND ITS MAIN MANUAL GAS SHUTOFF VALVE FROM THE GAS SUPPLY PIPING SYSTEM DURING ANY PRESSURE TESTING OF THE GAS SUPPLY SYSTEM OVER 1/2 PSIG (3.5kPa).. THE GAS SUPPLY LINE MUST BE CAPPED WHEN NOT CONNECTED TO THE BOILER.

THE BOILER MUST BE ISOLATED FROM THE GAS SUPPLY PIPING SYSTEM BY CLOSING ITS MAIN MANUAL GAS SHUTOFF VALVE DURING ANY PRESSURE TESTING OF THE GAS SUPPLY PIPING SYSTEM AT TEST PRESSURES EQUAL TO OR LESS THAN 1/2 PSIG (3.5kPa).

PURGING

Gas line purging is required with new piping or systems in which air has entered.

⚠ CAUTION

PURGING SHOULD BE PERFORMED BY PERSONS EXPERIENCED IN THIS TYPE GAS SERVICE TO AVOID RISK OF FIRE OR EXPLOSION. PURGE DISCHARGE MUST NOT ENTER CONFINED AREAS OR SPACES WHERE IGNITION CAN OCCUR. THE AREA MUST BE WELL VENTILATED AND ALL SOURCES OF IGNITION MUST BE INACTIVATED OR REMOVED.

1. CORRECT GAS

Make sure the gas on which the boiler will operate is the same as that specified on the boiler rating plate. Do not install the boiler if equipped for a different type gas — consult your supplier.

2A. SIZING GAS SUPPLY LINE (For single boiler installations and for installations of multiples of two or three of same size boilers).

Use table 6, or CAN/CSA B149.1-00 (latest recent edition) to size iron pipe or equivalent gas supply line. Table 6 is based on a pressure drop of 0.3 inches of water and a specific gravity of 0.60 approximately that of natural gas. (LP gas has an S.G. of about 1.53). If the service pressure is five inches water column or less, use one pipe size larger than specified in table 6 in order to minimize pressure drop in the line.

TABLE 6
MAXIMUM CAPACITY OF PIPE IN CUBIC FEET OF GAS PER HOUR (BASED UPON A PRESSURE DROP OF 0.3 INCH WATER COLUMN AND 0.6 SPECIFIC GRAVITY GAS)

Length Meters From Gas Meter	(Nominal Iron Pipe Size (Inches)								
	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4
3 (10)	132	278	520	1,050	1,600	3,050	4,800	8,500	17,500
6 (20)	92	190	350	730	1,100	2,100	3,300	5,900	12,000
9 (30)	73	152	285	590	890	1,650	2,700	4,700	9,700
12 (40)	63	130	245	500	760	1,450	2,300	4,100	8,300
15 (50)	56	115	215	440	670	1,270	2,000	3,600	7,400
18 ((60)	50	105	195	400	610	1,150	1,850	3,250	6,800
21 (70)	46	96	180	370	560	1,050	1,700	3,000	6,200
24 (80)	43	90	170	350	530	990	1,600	2,800	5,800
27 (90)	40	84	160	320	490	930	1,500	2,600	5,400
30 (100)	38	79	150	305	460	870	1,400	2,500	5,100
38 (125)	34	72	130	275	410	780	1,250	2,200	4,500
45 (150)	31	64	120	250	380	710	1,130	2,000	4,100
53 (175)	28	59	110	225	350	650	1,050	1,850	3,800
60 (200)	26	55	100	210	320	610	980	1,700	3,500

*The heating value of Natural Gas is approximately 1,050 Btu/Ft^{-3}.
Propane (LP) Gas has a heating value of approximately 2,500 Btu/Ft^3.
1 cu. meter=35.31 cu. feet.

Where it is necessary to use more than the average number of pipe fittings i.e. elbows, tees, and valves in gas supply line, use a pipe larger than specified to compensate for increased pressure drop.

2B. SIZING GAS SUPPLY LINE (For multiples of over three boilers of same size or for multiple installations of two or more mixed sizes).

Capacities in cubic feet per hour of 0.60 specific gravity gas for different sizes and lengths are shown in table 6. No additional allowance is necessary for an ordinary number of fittings.

Applications of the gravity factor converts the figures given in table 6 to capacities with another gas of different specific gravity. Such application is accomplished by multiplying the capacities given in table 6 by the multipliers shown in table 7.

To determine the size of each section of gas piping in a system within the range of table 6 proceed as follows:

- Determine the gas demand of each appliance to be attached to the piping system. When table 6 is to be used to select the piping size, calculate the gas demand in terms of cubic feet per hour for each piping system outlet. The gas demand for an appliance can be found by dividing its heat input rate by the gas's heating value.

- Obtain or determine the length of piping from the gas meter or service regulator to the appliance(s).

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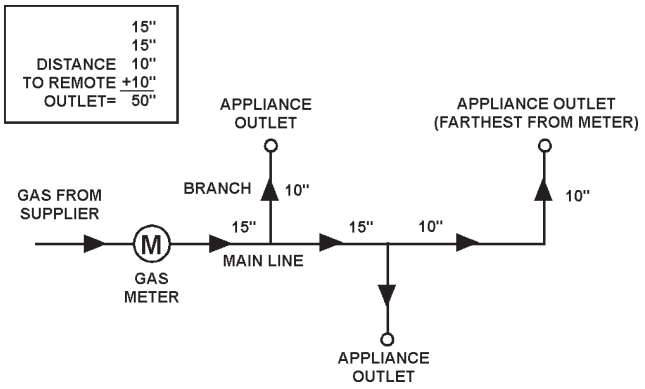
- In table 6, select the row showing the distance to the most remote outlet or the next longer distance if the table does not give the exact length. This is the only distance used in determining the size of any section of gas piping. If the gravity factor is to be applied, the values in the selected row of table 6 are multiplied by the appropriate multiplier from table 7.

- Total the gas demands of all appliances on the piping system. Enter table 6, on the left hand side, at the row equal to or just exceeding the distance to the most remote outlet. Select the pipe size in the row with a capacity equal to or just exceeding the total gas demand. This is the required main gas supply line size leading away from the gas meter or regulator. To determine the pipe size required for each branch outlet leading away from the main supply line, determine the gas demand for that outlet. Enter table 6 on the same row, and select the branch pipe size for a capacity equal to or just exceeding the demand at that outlet. The main line can be resized for a lesser capacity after each branch outlet, since the gas demand is reduced. Total the gas demands of all remaining appliances branching off downstream on the main gas line. Re-enter table 6 in the same row and select the appropriate pipe size with adequate capacity. Repeat the branch sizing and main line re-sizing for any remaining appliances in the system.



EXAMPLE

Job Condition:

Determining the required gas pipe size for a system composed of two HWB/HW-420 boilers and two HWB/HW-610 boilers to be installed as a multiple group, 50 lineal feet from meter. Gas to be used has a .60 specific gravity and heating value of 1,000 Btu per cubic foot.

Solution:

2 HWB/HW-420 Boilers = 840,000 Btuh
2 HWB/HW-610 Boilers = 1,220,000 Btuh

Total Btuh Input = 2,060,000 Btuh

Total Btuh Input = 2,060,000 Btuh = 2,060 cf/h

Btu per Cubic Foot of Gas 1,000

With a cubic foot per hour demand of 2,060 and with 50 lineal feet of gas supply line, table 6 shows a pipe size of 3" (76mm) is required.

NOTE: For other than .60 specific gravity, apply multiplier factor as shown in table 7.

TABLE 7
MULTIPLIERS TO BE USED WITH TABLE 6 WHEN APPLYING THE GRAVITY FACTOR TO OTHER THAN .60 SPECIFIC GRAVITY

Specific Gravity	Multiplier	Specific Gravity	Multiplier
.35	1.31	1.00	.78
.40	1.23	1.10	.74
.45	1.16	1.20	.71
.50	1.10	1.30	.68
.55	1.04	1.40	.66
*.60 (Nat.)	1.00	*1.50 (Prop.)	.63
.65	.96	1.60	.61
.70	.93	1.70	.59
.75	.90	1.80	.58
.80	.87	1.90	.56
.85	.84	*2.00 (Butane)	.55
.90	.82	2.10	.54

*Use these correction factors if exact specific gravity of the gas is not known.

GAS PRESSURE REGULATORS

The gas pressure regulator is included in the combination gas valve, fig. 6, and is set to operate on the gas specified on the boiler model and rating plate.

Periodically check main burner, fig. 41, and pilot flame, fig. 42, for proper operation. This should be checked every six months.

Do not subject the gas valve to inlet gas pressures of more than 14" W.C. (1/2 P.S.I.). If higher gas pressures are encountered, a service regulator is necessary.

TABLE 8
CORRECT MANIFOLD PRESSURE FOR FULL BOILER INPUT (IN INCHES OF WATER COLUMN)

Model Number	Rated Input	Manifold Pressure	
		Natural	Propane
HWB/HW-300	300,000	3.5	10.0
HWB/HW-399	399,000	3.2	9.5
HWB/HW-420	420,000	3.5	10.0
HWB/HW-520	520,000	3.5	10.0
HWB/HW-610	610,000	3.5	10.0
HW-670 Nat.	660,000	3.5	
HW-670 Prop.	670,000		10.0

Adjustment, if required, is performed as follows:

1. Set primary system temperature control dial (thermostat) at lowest setting so that boiler will not call for heat.
2. Attach a pressure gauge to the tapping in the control string elbow.
3. Reset primary system temperature control dial (thermostat) to highest setting. Main burner will now ignite.
4. With main burner firing, adjust pressure, if necessary, by turning pressure regulator adjusting screw with a screwdriver.
   - Clockwise to increase pressure.
   - Counterclockwise to decrease pressure.
5. Set primary system temperature control dial (thermostat) to lowest setting.
6. Remove pressure gauge and replace sealing plug.

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7. Set primary system temperature control dial (thermostat) to desired setting.

⚠ WARNING

DO NOT INCREASE GAS PRESSURE ABOVE THAT SPECIFIED ON THE RATING PLATE, AS OVERFIRING WILL RESULT IN DAMAGE TO THE BOILER, AS WELL AS INCREASED RISK OF FIRE, SOOTING AND ASPHYXIATION.

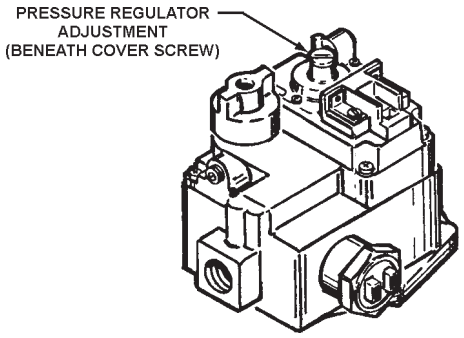
If gas pressure regulator cannot be adjusted to correct pressure with sufficient gas pressure at the valve, replace with new gas valve.

VENTING THE BOILER - STANDARD VENTING

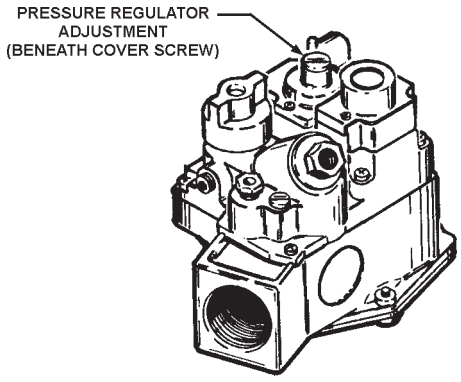
⚠ WARNING

THE INSTRUCTIONS IN THIS SECTION ON VENTING THE BOILER MUST BE FOLLOWED TO AVOID CHOKED COMBUSTION OR RECIRCULATION OF FLUE GASES. SUCH CONDITIONS CAUSE SOOTING OR RISKS OF FIRE AND ASPHYXIATION.

TYPE B VENTING MAY BE USED WITH THESE BOILERS. ALL LOCAL UTILITY REGULATIONS ON VENTING SHOULD BE FOLLOWED.



ROBERTSHAW® 7000 DERHC
HWB/HW-300, 399,-420, -520, -610, -670 NATURAL GAS WITH I.I.D.
HW-300, -399, -420, -520, -670 LP GAS WITH I.I.D. U.S. ONLY



ROBERTSHAW® 7000 ERHC (LP)
HWB/HW-300, 399,-420, -520, -610 SINGLE STAGE
STANDING PILOT, CANADIAN ONLY

FIGURE 6

For boilers for connection to gas vents or chimneys, vent sizing, installation and termination shall be in accordance with Part 7, Venting of Equipment, of the National Fuel Gas Code, ANSI Z223.1, or Section 7, Venting Systems and Air Supply for Appliances, of the CAN/CSA B149.1-00, Installation Codes, or applicable provisions of the local building codes.

Vent connectors serving appliances vented by natural draft shall not be connected into any portion of mechanical draft systems operating under positive pressure.

The minimum distance from adjacent public walkways, adjacent buildings, openable windows and building openings shall not be less than those values specified in the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CSA B149.1-00, Installation Codes;

Stack or chimney must be a minimum height of 12" (305mm) above the annual snow fall to prevent blockage.

Building materials must not come in contact with combustion products from stack or chimney, due to the degradating properties of flue products.

Flue products must have a minimum clearance of 4 feet (1.22m) horizontally from, and in no case above or below, unless a 4-foot (1.22m) horizontal distance is maintained, from electric meters, gas meters, regulators and relief equipment.

The Canadian B149.1-00, Installation Code specifies a 6 foot horizontal vent terminal clearance to gas and electric meters and relief devices (this clearance is specified as 4 feet in the U.S. under the National Fuel Gas Code, ANSI/Z223.1). Therefore instruction provision 134.1-b19(d), which specifies compliance with the 4 foot clearance, as applies in the U.S. only, and the B149.1-00 Installation Code applies in Canada.

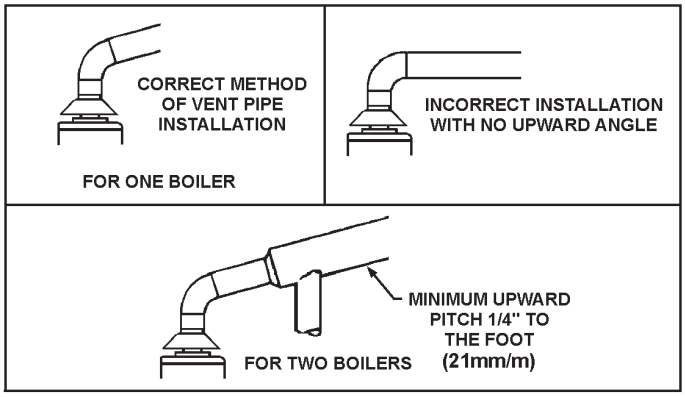
1. DRAFT HOOD

The draft hood furnished with this boiler must be installed without alteration. Provision must be made if the boiler is installed in confined space or a small boiler room to accommodate draft hood spillage and avoid risks described above. The upper air opening called for in the AIR REQUIREMENTS section of this manual is for this purpose.

2. VENT CONNECTION

Size and install proper size vent pipe. Do not reduce pipe size to less than that of the draft hood outlet.

Horizontal runs of vent pipe shall be securely supported by adequately placed (approximately every 4 feet or 1 meter), noncombustible hangers and/or slip joints suitable for the weight and design of the materials employed to prevent sagging and to maintain a minimum upward slope of 1/4" (21mm/m) per foot from the boiler to the vent terminals, fig. 7. Dampers or other obstructions must not be installed in the vent. Be sure that the vent pipe does not extend beyond the inside wall of the chimney.



VENT PIPE INSTALLATION
FIGURE 7

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Where a continuous or intermittent back draft is found to exist the cause must be determined and corrected. A special vent cap may be required. If the back draft cannot be corrected by the normal methods or if a suitable draft cannot be obtained, a blower type flue gas exhauster may be employed to ensure proper venting and correct combustion if permitted by local codes.

WARNING

FAILURE TO CORRECT BACK DRAFTS WILL CAUSE AIR CONTAMINATION AND UNSAFE CONDITIONS.

Vent connectors serving appliances vented by natural draft shall not be connected into any portion of mechanical draft systems operating under positive pressure.

3. CONNECTING BOILER TO A COMMON VENT

Do not connect the boiler to a common vent or chimney with solid fuel burning equipment. This practice is prohibited by many local building codes as is the practice of venting gas fired equipment to the duct work of ventilation systems.

Where a separate vent connection is not available and the vent pipe from the boiler must be connected to a common vent with oil burning equipment, the vent pipe should enter the common vent or chimney at a point ABOVE the flue pipe from the oil fired unit.

Where two or more appliances vent into a common vent connector or manifold, the area of the common vent or vent connector should at least equal the area of the largest vent connector plus 50% of the areas of the additional draft hood outlets.

When removing a boiler from a system with a common vent, use the following steps:

Be sure the other appliances connected to the common vent are not in operation.

Seal any unused openings in the common venting system.

Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.

WARNING

Ensure sufficient supply and ventilation air. Under no circumstances should the equipment room where the boiler is installed ever be under negative pressure. Insufficient air supply can interfere with combustion and ventilation of this boiler resulting in unsafe conditions.

Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Close fireplace dampers.

Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

Test for spillage at the draft hood relief opening after five minutes of main burner operation. Use the flame of a match or candle.

After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their previous conditions of use.

Any improper operation of the common venting system should be corrected so the installation conforms with the latest edition of CAN/CGA B149.1-00 (latest edition). When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Appendix G in CAN/CSA B149.1-00.

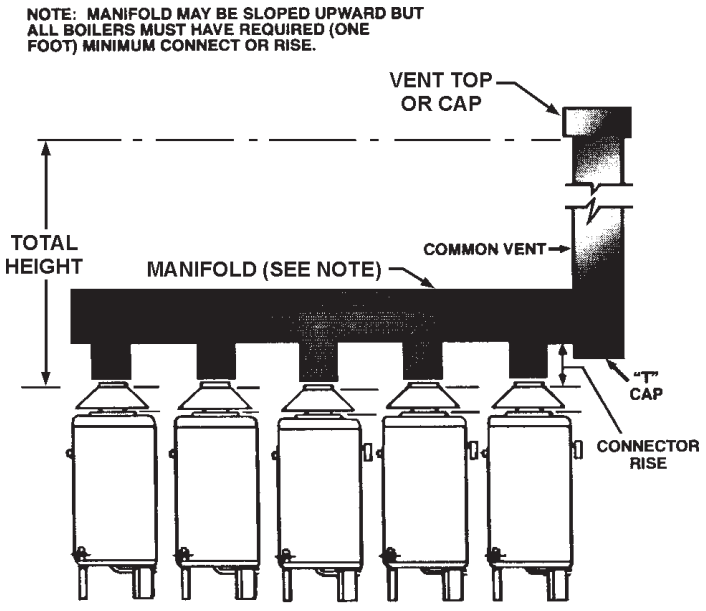
4. MULTIPLE VENT TABLE

Table 9 has been compiled to show the material sizes in a Type B doublewall combined vent system. Refer to CAN/CSA B149 .1-00 (latest edition), or the ASHRAE 1983 Equipment Volume for further information.

A combined vent system is one in which two or more boilers at one level are attached to a common vent.

In order to use table 9, the connector rise and total vent height must be known. Connector rise is vertical distance from the draft hood outlet to the point where the manifold connection is made. Total vent height is the least vertical distance from a draft hood outlet to the top of the vent. Local codes or utility requirements often govern termination height. ULC listed doublewall gas vents, up through 24" (610mm) diameter, can be installed in heated and unheated areas and can pass through floors, ceilings, partitions, walls and roofs, provided the required one inch clearance is observed. These vents should be installed in accordance with CAN/CSA B149.1-00 (latest edition).

EXAMPLE SHOWING USE OF THE HWB/HW-610 COMBINED VENT SIZING TABLE 9


NOTE: MANIFOLD MAY BE SLOPED UPWARD BUT ALL BOILERS MUST HAVE REQUIRED (ONE FOOT) MINIMUM CONNECT OR RISE.
VENT TOP OR CAP
TOTAL HEIGHT
COMMON VENT
MANIFOLD (SEE NOTE)
"T" CAP
CONNECTOR RISE

NOTE:
MANIFOLD LENGTH FROM THE BASE OF THE VERTICAL VENT TO THE NEAREST APPLIANCE SHOULD NOT EXCEED 10 FEET OR 50% OF THE TOTAL VENT HEIGHT, WHICHEVER IS GREATEST.

FIGURE 8

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TABLE 9, COMBINED VENT SIZING TABLES

MODEL HW/HWB-300 BOILER

Input: 300,000 Btuh		Draft Hood Outlet 8"								
Required Connector or Smoke Pipe Diameter										
	Connector Rise in Feet	Total Vent Height(Measured in Feet Above Draft Hood)								
		10	15	20	30	40	50	60	80	100
		Connector Diameter (in Inches)								
	1	10	10	10	10	10	10	10	10	10
	2	10	10	10	10	10	10	10	10	10
	3	10	10	10	10	10	10	10	10	10
	4 or more									
Number if Units Combined	Total Input Btuh x 1000	Total Vent Height(Measured in Feet Above Draft Hood)								
		10	15	20	30	40	50	60	80	100
		Manifold and Common Vent Diameter (in Inches)*								
2	600	14	12	12	12	10	10	10	10	10
3	900	16	14	14	14	12	12	12	12	12
4	1200	18	16	16	14	14	14	14	12	12

MODEL HW/HWB-399 BOILER

Input: 399,000 Btuh		Draft Hood Outlet 10"								
Required Connector or Smoke Pipe Diameter										
	Connector Rise in Feet	Total Vent Height(Measured in Feet Above Draft Hood)								
		10	15	20	30	40	50	60	80	100
		Connector Diameter (in Inches)								
	1	12	12	12	12	12	12	12	12	12
	2	12	12	12	10	10	10	10	10	10
	3	12	10	10	10	10	10	10	10	10
	4 or more	10	10	10	10	10	10	10	10	10
Number if Units Combined	Total Input Btuh x 1000	Total Vent Height(Measured in Feet Above Draft Hood)								
		10	15	20	30	40	50	60	80	100
		Manifold and Common Vent Diameter (in Inches)*								
2	798	14	14	14	12	12	12	12	12	12
3	1197	18	16	16	14	14	14	14	14	12
4	1596	20	20	18	16	16	16	14	14	14

MODEL HW/HWB-420 BOILER

Input: 420,000 Btuh		Draft Hood Outlet 10"								
Required Connector or Smoke Pipe Diameter										
	Connector Rise in Feet	Total Vent Height(Measured in Feet Above Draft Hood)								
		10	15	20	30	40	50	60	80	100
		Connector Diameter (in Inches)								
	1	12	12	12	12	12	12	12	12	12
	2	12	12	12	10	10	10	10	10	10
	3	12	10	10	10	10	10	10	10	10
	4 or more	10	10	10	10	10	10	10	10	10
Number if Units Combined	Total Input Btuh x 1000	Total Vent Height(Measured in Feet Above Draft Hood)								
		10	15	20	30	40	50	60	80	100
		Manifold and Common Vent Diameter (in Inches)*								
2	840	14	14	14	12	12	12	12	12	12
3	1260	18	16	16	14	14	14	14	14	12
4	1680	20	20	18	16	16	16	14	14	14

MODEL HW/HWB-520 BOILER

Input: 520,000 Btuh		Draft Hood Outlet 10"								
Required Connector or Smoke Pipe Diameter										
	Connector Rise in Feet	Total Vent Height(Measured in Feet Above Draft Hood)								
		10	15	20	30	40	50	60	80	100
		Connector Diameter (in Inches)								
	1	14	14	14	12	12	12	12	12	12
	2	12	12	12	12	12	12	12	12	12
	3	12	12	12	12	10	10	10	10	10
	4 or more	12	12	12	12	10	10	10	10	10
Number if Units Combined	Total Input Btuh x 1000	Total Vent Height(Measured in Feet Above Draft Hood)								
		10	15	20	30	40	50	60	80	100
		Manifold and Common Vent Diameter (in Inches)*								
2	1040	16	16	14	14	14	14	12	12	12
3	1560	20	18	18	16	16	14	14	14	14
4	2080	22	22	20	18	18	18	16	16	14
5	2600	26	24	22	20	20	18	18	18	18
6	3120	28	26	24	22	22	20	20	18	18
7	3640	30	28	26	24	24	22	22	20	20
8	4160	32	30	28	26	24	24	22	22	20

MODEL HW/HWB-610 BOILER

Input: 610,000 Btuh		Draft Hood Outlet 12"								
Required Connector or Smoke Pipe Diameter										
	Connector Rise in Feet	Total Vent Height(Measured in Feet Above Draft Hood)								
		10	15	20	30	40	50	60	80	100
		Connector Diameter (in Inches)								
	1	16	14	14	14	14	14	14	14	14
	2	14	14	14	14	14	12	12	12	12
	3	14	14	12	12	12	12	12	12	12
	4 or more	12	12	12	12	12	12	12	12	12
Number if Units Combined	Total Input Btuh x 1000	Total Vent Height(Measured in Feet Above Draft Hood)								
		10	15	20	30	40	50	60	80	100
		Manifold and Common Vent Diameter (in Inches)*								
2	1220	18	18	16	16	14	14	14	14	14
3	1830	22	20	20	18	18	16	16	16	14
4	2440	26	24	22	20	20	18	18	18	16
5	3050	28	26	26	24	22	22	20	20	18
6	3660	32	28	28	26	24	24	22	22	20
7	4270	34	32	30	28	26	24	24	22	22
8	4880	36	34	32	30	28	26	26	24	24
9	5490	38	36	34	30	30	28	28	26	24
10	6100	40	38	36	32	30	30	28	26	26
11	6710	42	38	38	34	32	30	28	28	26
12	7320	44	42	38	36	34	32	32	30	28

MODEL HW/HWB-670 BOILER

Input: 660,000 or 670,000 Btuh		Draft Hood Outlet 12"								
Required Connector or Smoke Pipe Diameter										
	Connector Rise in Feet	Total Vent Height(Measured in Feet Above Draft Hood)								
		10	15	20	30	40	50	60	80	100
		Connector Diameter (in Inches)								
	1	16	14	14	14	14	14	14	14	14
	2	14	14	14	14	14	12	12	12	12
	3	14	14	12	12	12	12	12	12	12
	4 or more	12	12	12	12	12	12	12	12	12
Number if Units Combined	Total Input Btuh x 1000	Total Vent Height(Measured in Feet Above Draft Hood)								
		10	15	20	30	40	50	60	80	100
		Manifold and Common Vent Diameter (in Inches)*								
2	1340	18	18	16	16	14	14	14	14	14
3	2010	22	20	20	18	18	16	16	16	14
4	2680	26	24	22	20	20	18	18	18	16
5	3350	28	26	26	24	22	22	20	20	18
6	4020	32	28	28	26	24	24	22	22	20
7	4690	34	32	30	28	26	24	24	22	22
8	5360	36	34	32	30	28	26	26	24	24
9	6030	38	36	34	30	30	28	28	26	24
10	6700	40	38	36	32	30	30	28	26	26
11	7370	42	38	38	34	32	30	28	28	26
12	8040	46	44	40	38	36	34	34	32	30

Known: (5) model HWB/HW-610 boilers. (See illustration). Connector rise - 2' (Note 1' is minimum). Total vent height 30'.

Problem: Determine diameter of connector, manifold and common vent.

Procedure: Enter the top of the HWB/HW-610 table (total vent height) at 30' and the side at 2' (connector rise). A 14" connector diameter is indicated for each connector rise.

To determine the manifold and common vent size, enter this table (total vent height) at 30 and the side at 5 boilers. A manifold diameter of 24" (610mm) is indicated.

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VENTING MAINTENANCE - STANDARD VENTING

It is recommended that the heating surfaces and vent piping of the appliance be checked every six months for dust, deterioration and carbon deposits. Remove all soot or other obstructions from chimney and flue which will retard free draft. Replace any damaged or deteriorated parts of the venting system.

Qualified servicers should follow this procedure when the boiler's external heating surfaces and vent pipe need cleaning.

⚠ CAUTION

DO NOT USE A NYLON BRUSH OR OTHER STATIC CREATING MATERIAL TO CLEAN DUST AND CARBON DEPOSITS FROM HEATING SURFACES AND VENT.

SUCH DEPOSITS ARE FLAMMABLE AND MAY BE IGNITED BY STATIC ELECTRICITY. USE A METAL BRUSH TO MINIMIZE THE DANGER OF EXPLOSION.

1. Turn off the electrical power (main manual gas shutoff and pilot valves, if applicable).

   Allow boiler parts and vent to cool before disassembly.

2. Remove the boiler draft diverter and vent pipe running to the chimney.
   - Check parts and chimney for obstructions and clean as necessary.

3. Remove burner from boiler and other metal parts as required to clean and vacuum the heat exchanger and combustion coils.
   - Refer to parts list supplied with this manual for disassembly aid.

4. Reinstall the parts removed in steps 2 and 3.
   - Be sure the vent pipe has a minimum upward pitch of one quarter inch per foot of length (21mm/m) and is sealed as necessary.

5. Restore electrical power and gas supply to boiler.
   - Place boiler in operation by following the lighting instructions in this manual.
   - Check for gas leaks and proper boiler and vent operation.

VENTING - SIDEWALL (OPTIONAL) POWER VENT SYSTEM

If you are installing the optional Power Vent Kit, refer to your HWB/HW Power Vent Kit Installation Instructions for proper wiring and installation procedures. Contact your local A.O. Smith representative for details.

VENTING SYSTEM

HAVE VENTING SYSTEM CHECKED EVERY SIX MONTHS FOR OBSTRUCTIONS AND/OR DETERIORATION IN VENT PIPING.

A. Insofar as is practical, close all doors, windows and air inlets to the building. Turn on all exhaust fans (range hood, bathroom exhaust, etc.) so they will operate at their maximum speed. Close fireplace dampers.

B. After allowing appliance to operate for five minutes, test for spillage at the draft hood relief opening.

C. "CHECKING THE DRAFT. Operate vent connected gas utilization equipment for several minutes and check to see that the combustion products are going up the chimney or gas vent properly by passing a lighted match or taper around the edge of the relief opening of the draft hood. If the chimney or gas vent is drawing properly, the match flame will be drawn into the draft hood. If not, the combustion products will tend to extinguish this flame. IF THE COMBUSTION PRODUCTS ARE ESCAPING FROM THE RELIEF OPENING OF THE DRAFT HOOD, DO NOT OPERATE THE EQUIPMENT UNTIL PROPER ADJUSTMENT OR REPAIRS ARE MADE TO PROVIDE ADEQUATE DRAFT THROUGH THE CHIMNEY OR GAS VENT."

D. Next, turn on all other fuel burning appliances within the same room so they will operate at their full input.

   Repeat step C above, checking the draft on each appliance.

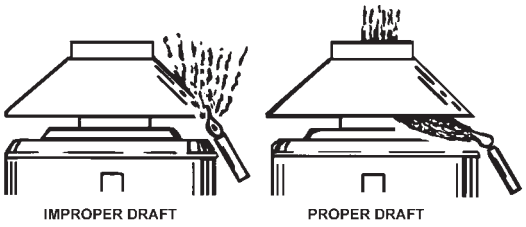

FIGURE 9

SAFETY RELIEF VALVES

Your local code authority may have other specific relief valve requirements not covered below.

⚠ WARNING

THE PURPOSE OF A SAFETY RELIEF VALVE IS TO AVOID EXCESSIVE PRESSURE OR TEMPERATURE INTO THE STEAM RANGE WHICH MAY CAUSE SCALDING AT FIXTURES, TANK EXPLOSION, SYSTEM OR BOILER DAMAGE.

TO AVOID SCALDING OR WATER DAMAGE A DRAIN LINE MUST BE CONNECTED TO A RELIEF VALVE TO DIRECT DISCHARGE TO A SAFE LOCATION. A DRAIN LINE MUST NOT BE REDUCED FROM THE SIZE OF THE VALVE OUTLET AND IT MUST NOT CONTAIN ANY VALVES BETWEEN THE BOILER AND THE RELIEF VALVE OR THE RELIEF VALVE AND THE DRAIN EXIT. IN ADDITION, THERE SHOULD NOT BE ANY RESTRICTIONS IN A DRAIN LINE NOR SHOULD IT BE ROUTED THROUGH AREAS WHERE FREEZING CONDITIONS MIGHT OCCUR. DO NOT THREAD OR CAP THE DRAIN LINE EXIT. RESTRICTING OR BLOCKING A DRAIN LINE WILL DEFEAT THE PURPOSE OF THE RELIEF VALVE AND MAY CREATE AN UNSAFE CONDITION. INSTALL A DRAIN LINE WITH A DOWNWARD SLOPE SUCH THAT IT NATURALLY DRAINS ITSELF.

If any safety relief valve is replaced, the replacement valve must comply with the latest version of the ASME Boiler and Pressure Vessel Code, Section IV or CSA B51, as applicable. Select a relief valve with a discharge NOT less than the boiler input, and a pressure rating NOT exceeding the working pressure of any component in the system.

A. O. Smith supplies Canadian HW boilers for hot water supply systems with a 125 psi pressure relief valve. This valve must be installed in the water outlet as near to the boiler as possible.

A. O. Smith United States HW and Canadian HWB boilers for space heating are shipped with a 50 psi pressure relief valve. This valve must be installed in the water outlet as near to the boiler as possible.

An ASME rated temperature and pressure relief valve must be installed on each and every water storage tank in a hot water supply system.

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The storage tank temperature and pressure (T & P) relief valve must comply with the applicable construction provisions of the Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems, Z21.22 and/or CAN1-4.4. The T & P valve must be of the automatic reset type and not embody a single-use type fusible plug, cartridge or linkage.

The T & P relief valve should have a maximum temperature rating of 100^{0}C (210^{0}F), a pressure rating NOT exceeding the lowest rated working pressure of any system component, and a discharge capacity exceeding the total input of the water boilers supplying water to the storage tank.

Locate the T & P relief valve (a) in the top of the storage tank, or (b) in the side of the tank on centerline within the upper 6 inches from the top of the tank. See figures 20 to 31. Tapping shall be threaded in accordance with the latest version of the Standard for Pipe Threads, General Purpose (inch), ANSI/ASME B1.20.1

Mark location with a Class lll label.

See ANSI Z21.10.1, Part 1, MARKING, See CAN/CSA B149.1-00.

WIRING CONNECTIONS

CAUTION

LABEL ALL WIRES PRIOR TO DISCONNECTION WHEN SERVICING CONTROLS. WIRING ERRORS CAN CAUSE IMPROPER AND DANGEROUS OPERATION.
VERIFY PROPER OPERATION AFTER SERVICING.

1. CONVENTIONAL INSTALLATIONS

ALL ELECTRICAL WORK MUST BE INSTALLED IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE, ANSI/NFPA 70 AND/OR THE CANADIAN ELECTRICAL CODE, PART 1, CSA C22.1, ELECTRICAL CODE AND MUST CONFORM TO LOCAL REGULATIONS.

The boiler, when installed, must be electrically bonded to ground in accordance with the requirements of the authority having jurisdiction or, in the absence of such requirements, with the National Electrical Code, ANSI/NFPA 70 and/or the Canadian Electrical Code Part 1, CSA C22.1, Electrical Code.

STRICT ADHERENCE TO PIPING AND WIRING DIAGRAMS IS REQUIRED TO PREVENT CONSTANT PUMP OPERATION WHEN SYSTEM TEMPERATURE CONTROL IS SATISFIED. OTHERWISE THE WARRANTY IS VOID AS STIPULATED IN THE LIMITED WARRANTY ON THE INSTRUCTIONS MANUAL.

The electrical connections must be made so that the circulator will operate before the gas valve opens. At no time may the controlling system allow the burner to fire when there is no water flow through the boilers.

Refer to the diagrams in fig's. 10 thru 11C for proper wiring sequence with conventional single boiler installations.

The THERMAL BALANCER shown is factory included by A. O. Smith as part no. 98190. This device serves as a pump shutdown delay switch to balance the rising boiler water temperature to system temperature before the pump stops. Overshooting of boiler temperature is prevented and stack loss after shutdown is negligible.

WARNING

AN ELECTRICAL GROUND IS REQUIRED TO REDUCE RISK OF ELECTRIC SHOCK OR POSSIBLE ELECTROCUTION. Make the ground connection to the screw provided in the electrical supply junction box on the boiler.

IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE 105^{0}C WIRE OR ITS EQUIVALENT, EXCEPT FOR THE FLAME SENSOR AND IGNITION CABLE WHICH ARE 250^{0}C AND WIRES CONNECTED TO THE COIL PROTECTOR WHICH ARE 200^{0}C.

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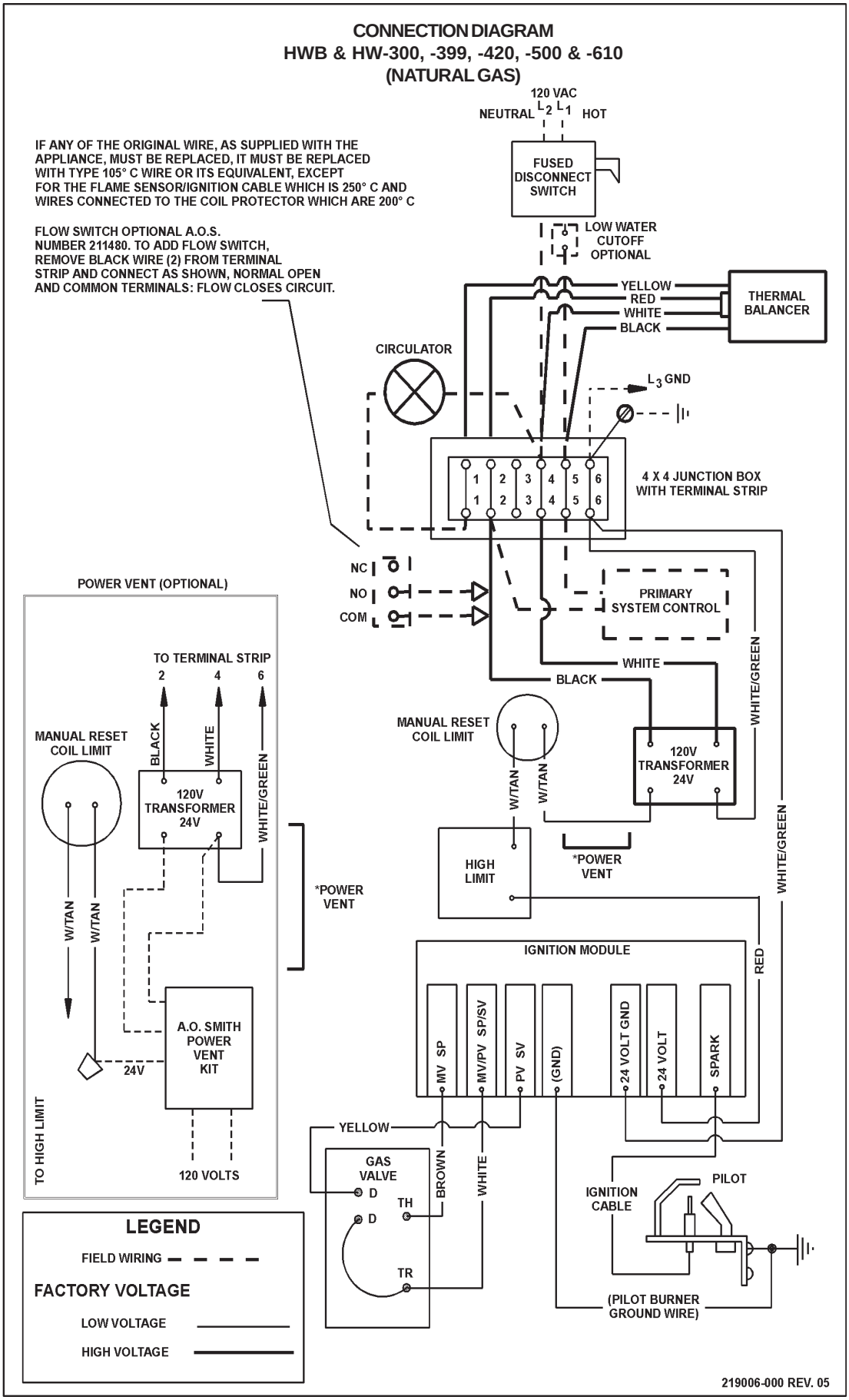

SINGLE STAGE I.I.D. - ROBERTSHAW® GAS VALVE
HWB & HW-300, -399, -420, -520, -610 (NATURAL GAS ONLY) - CANADIAN MODELS
FIGURE 10

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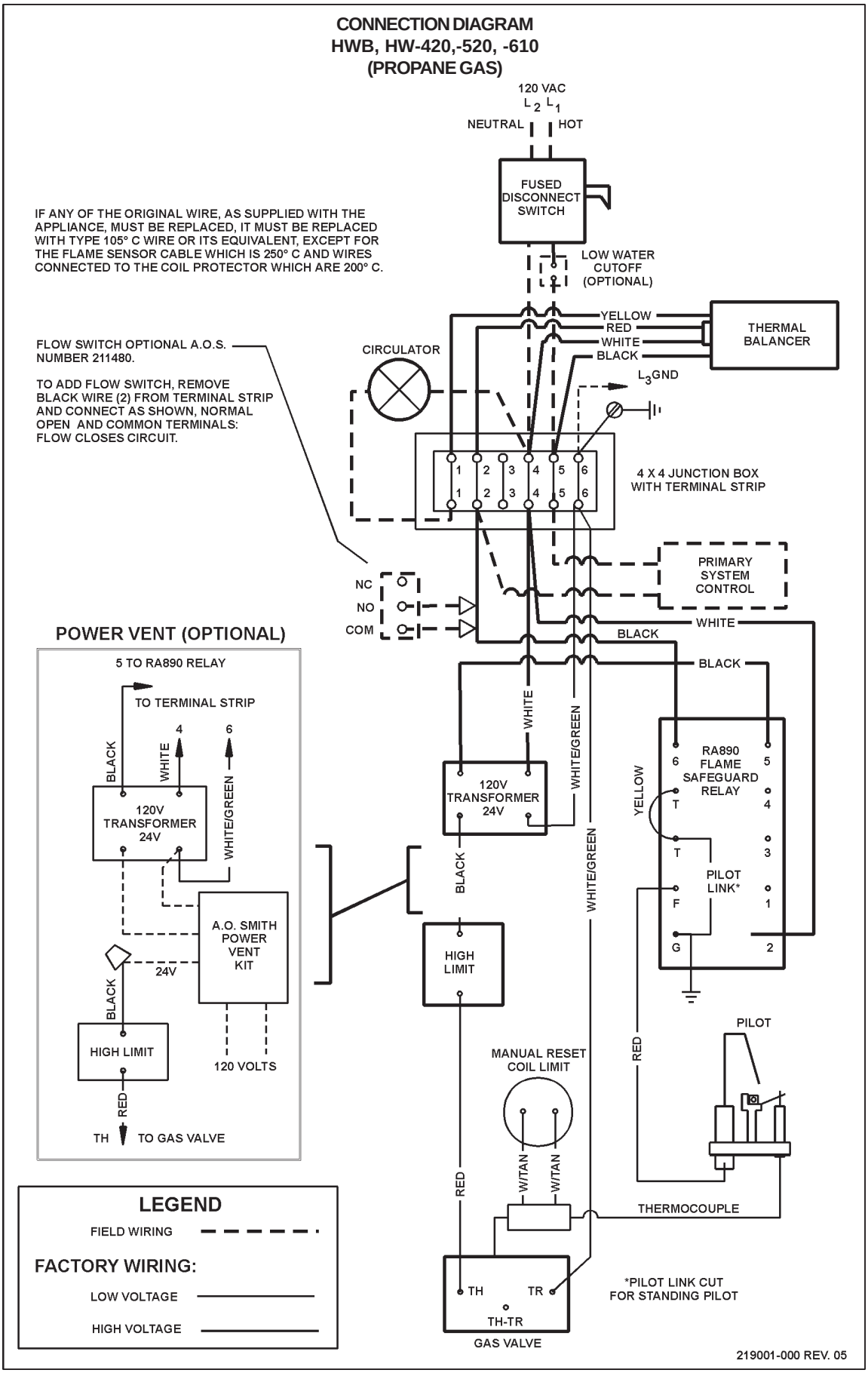

SINGLE STAGE PROPANE - ROBERTSHAW GAS VALVE
24 VOLT -HW, HWB-420, -520, -610 CANADIAN MODELS
FIGURE 11

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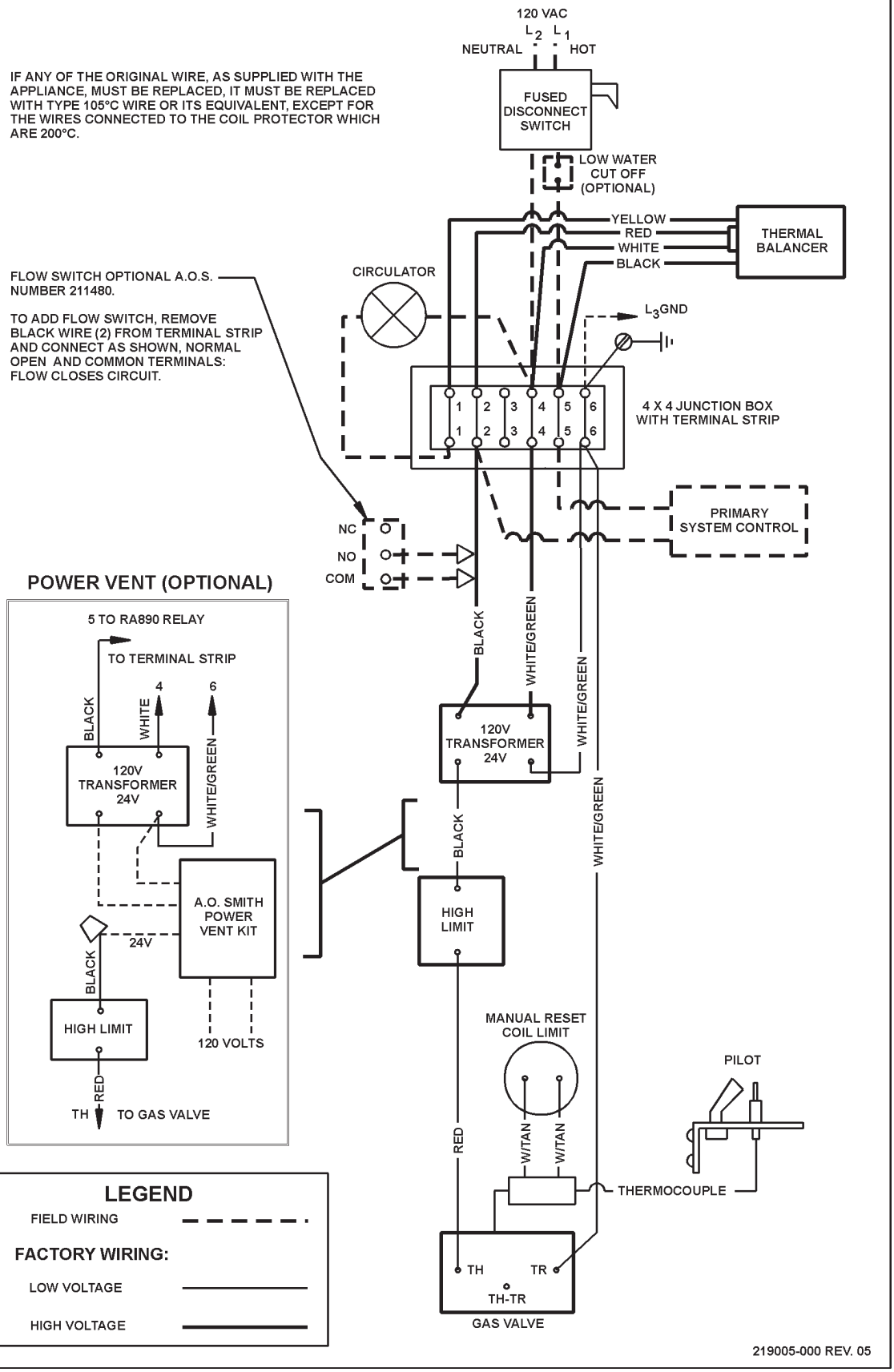
CONNECTION DIAGRAM HWB & HW 300, 399
(PROPANE GAS)
FIGURE 13



SINGLE STAGE PROPANE ROBERTSHAW GAS VALVE
24 VOLT - HWB, HW-300, 399 CANADIAN MODELS
FIGURE 11A

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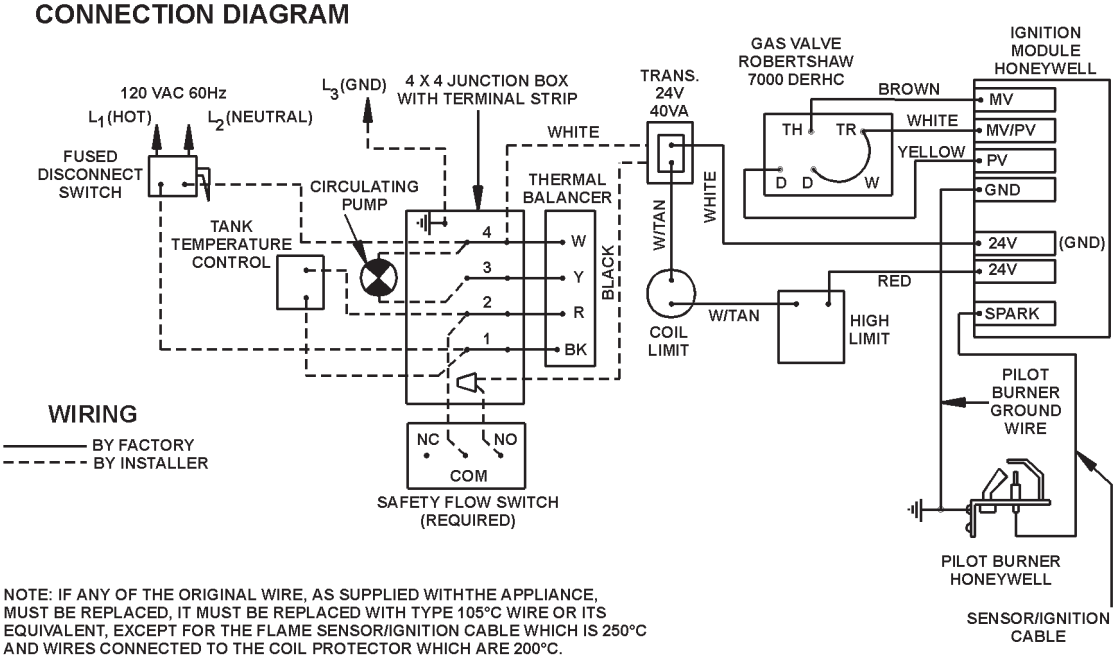
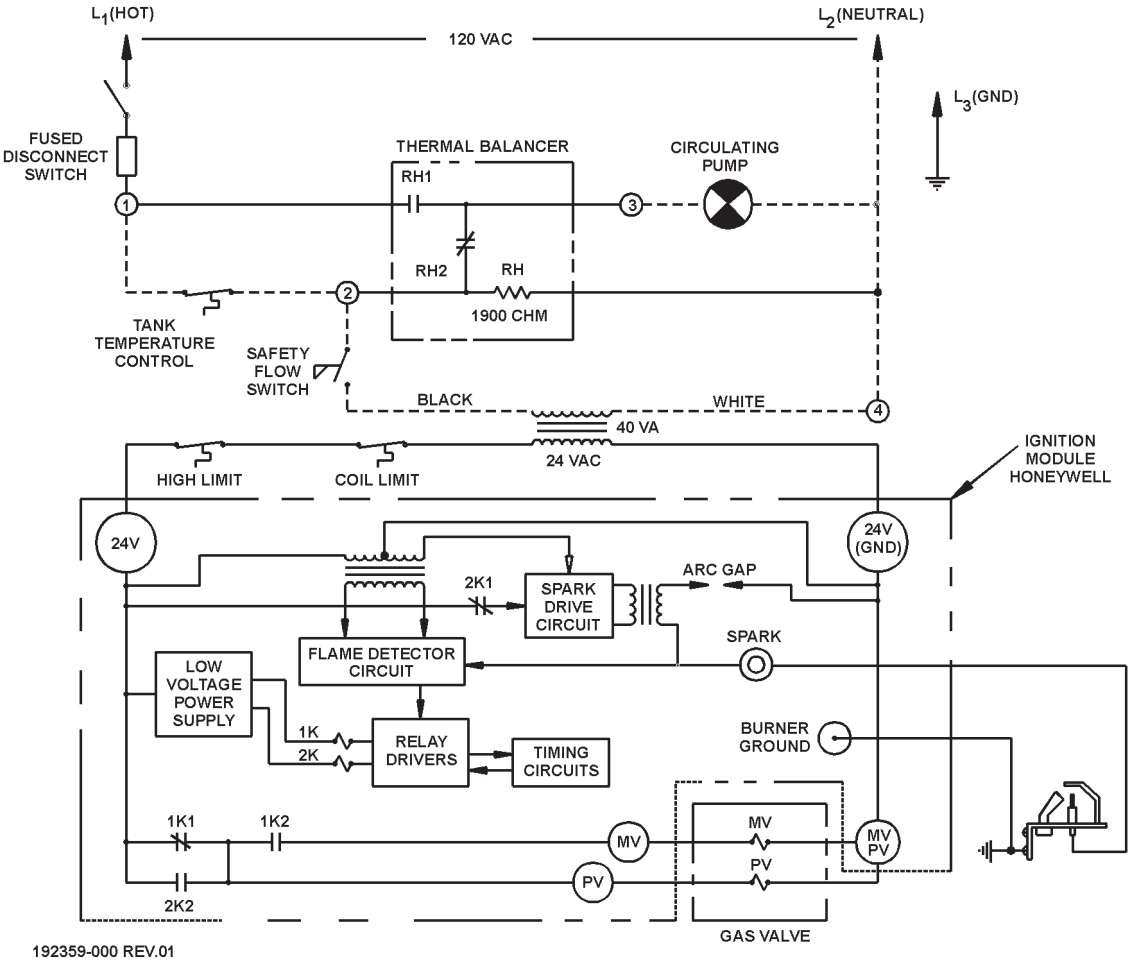
HW-300, HW-399, HW-420, HW-500 & HW-670
(NATURAL GAS)

CONNECTION DIAGRAM



NOTE: IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITHTHE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE 105°C WIRE OR ITS EQUIVALENT, EXCEPT FOR THE FLAME SENSOR/IGNITION CABLE WHICH IS 250°C AND WIRES CONNECTED TO THE COIL PROTECTOR WHICH ARE 200°C.

SCHEMATIC DIAGRAM



SINGLE STAGE I.I.D. - ROBERTSHAW GAS VALVE
HW-300, -399, -420, -520 & 670 (NATURAL GAS ONLY) - U.S. MODELS
FIGURE 11B

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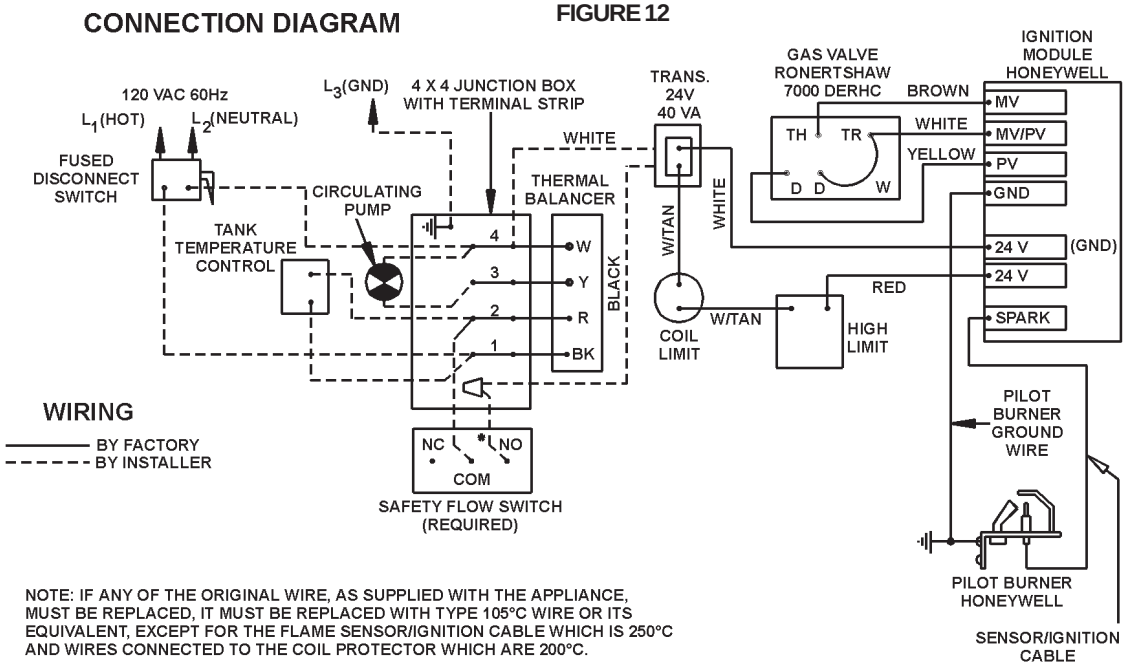
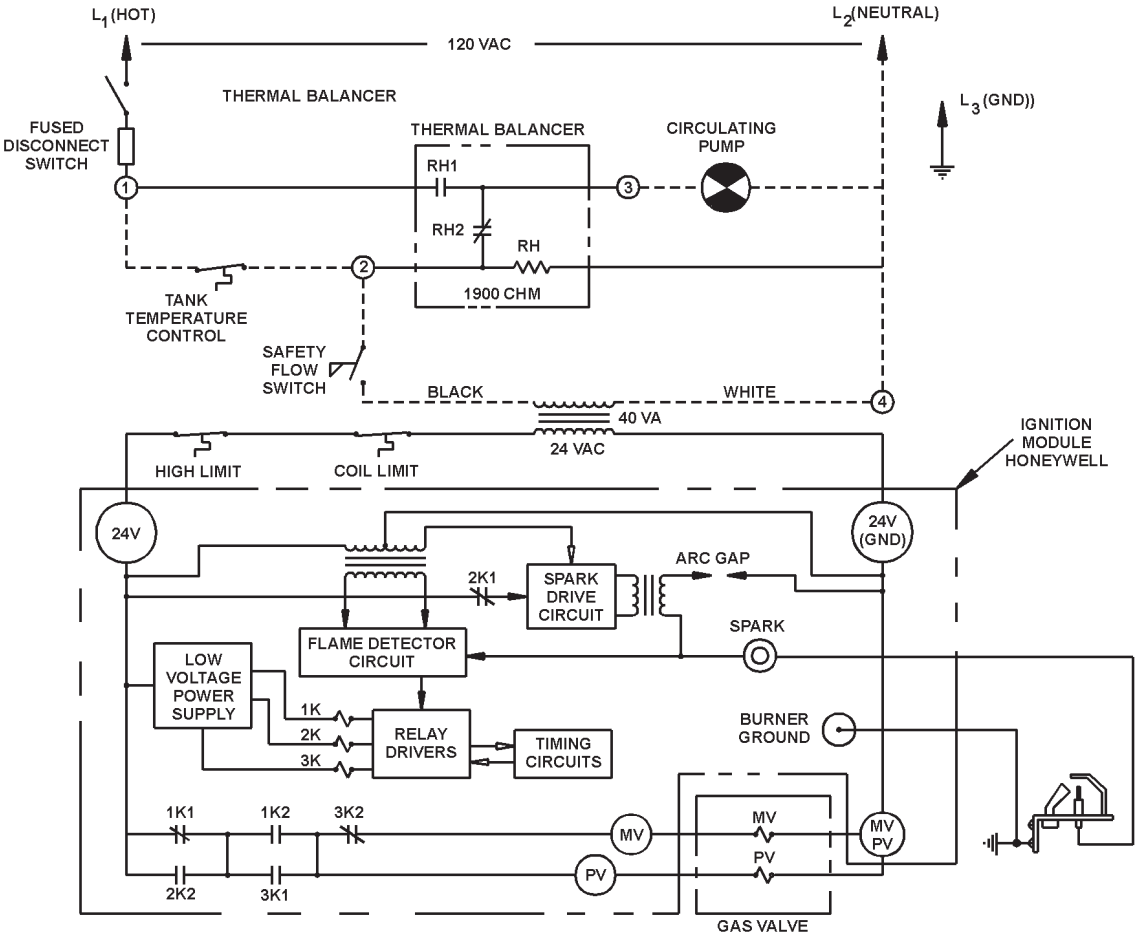
HW-300, HW-399, HW-420, HW-500 & HW-670
(PROPANE GAS)
FIGURE 12

CONNECTION DIAGRAM



NOTE: IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE 105°C WIRE OR ITS EQUIVALENT, EXCEPT FOR THE FLAME SENSOR/IGNITION CABLE WHICH IS 250°C AND WIRES CONNECTED TO THE COIL PROTECTOR WHICH ARE 200°C.

SCHEMATIC DIAGRAM



192360-000 REV. 01

SINGLE STAGE I.I.D. - ROBERTSHAW GAS VALVE
HW-300, -399, -420, -520 & 670 (PROPANE GAS ONLY) - U.S. MODELS
FIGURE 11C

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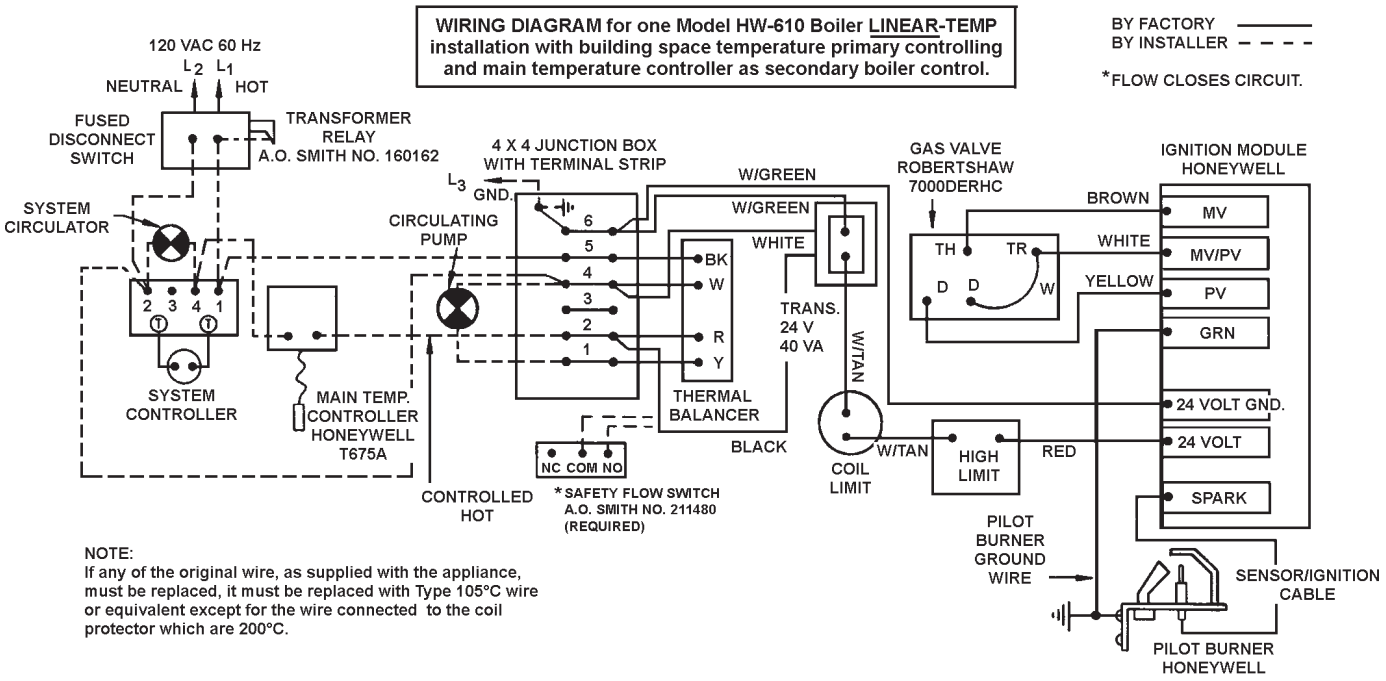

TYPICAL WIRING DIAGRAM (IID NATURAL GAS) FOR SINGLE BOILER LINEAR-TEMP® INSTALLATION FOR CANADIAN MODELS
FIGURE 12

2. LINEAR-TEMP INSTALLATIONS

Control for these systems is decided mainly by the type of building system controlling that is desired. A single boiler installation might be controlled directly from space temperature thermostat(s). Multiple boiler installations are more effective when the boilers are sequenced in and out of operation by some form of main water temperature controller. With one to three boilers, individual controls set at progressive temperatures may be used. For more than three or four boilers, a step controller is recommended.

Individual boiler controls, or the separate stages of a step controller, should fire a boiler and also start the boiler loop circulator whenever the first boiler of a group supplied by that boiler loop is fired. Some large installations may require the firing of more than one boiler per stage.

The system or primary circulator may or may not be controlled by the boiler sequencer. When this pump is operated through the first switch of any type of step controller, care should be taken to determine if a motor starter is needed due to insufficient switch capacity.

If the primary pump is controlled by a manual switch or any other controllers, the electric current supply to the boiler group should be through the primary pump controller. The fast response of A. O. Smith boilers eliminates any need to maintain boiler temperature when the system is satisfied. Wiring should always prevent firing of boiler(s) when there is no water flow in the mains.

Installation diagrams show flow switches in the outlet piping from each boiler as good protection against any boiler being fired when the boiler loop circulator is not in operation. These flow switches will also serve as protection if there is a loss of water.

Outdoor vent systems will normally require an automatic shutdown control if there is a continuous recirculating main and/or if the entire building is not under control of space temperature thermostats. A single bulb outdoor sensing control will prevent overheating of halls, stairways or other uncontrolled areas. There are occasions when outdoor temperatures are temporarily too warm for even a moderate amount of heating in these areas.

Space temperature controlling can be varied to meet the building requirements. Either the single thermostat, as shown, or multiple zone thermostats should control a common relay. This relay controls electric power to the system primary circulator and to the main water temperature controller. This provides for water movement in the system before the main temperature controller can start the secondary circulating pump or fire the boiler.

Figure 12 shows a typical wiring diagram for a single boiler space heating installation. The boiler may be controlled by a main temperature controller as shown or may include outdoor reset if desired. The boiler shown is the model HW-610 with single stage firing, typical of HW models.

Figure 13 shows a layout for various choices of controls often found in commercial heating. These layouts are not intended to be wiring diagrams and only show the relation of one device to another in the system.

Figure 13 is a typical layout of controls for two boilers with one circulator and including optional outdoor reset and thermal balancer. If a secondary circulator is used with each boiler, arrangement for boiler no. 2 will be as shown for boiler no. 1.

Commercial size installations are always best when designed to individual building requirements.

The layout in figure 13 is typical of many combination possibilities to meet the requirements of different buildings. Brand names of controls shown are suggestions and not directly related to any particular type of system. THESE LAYOUTS ARE NOT WIRING DIAGRAMS.

A.O. Smith offers accessory Sequencing Control Panels;
TEK-252 for 2 Stage Boiler Control
TEK-254 for 4 Stage Boiler Control
TEK-258 for 8 stage Boiler Control

For more information contact A.O. Smith Product Service Department at 1-800-433-2545.

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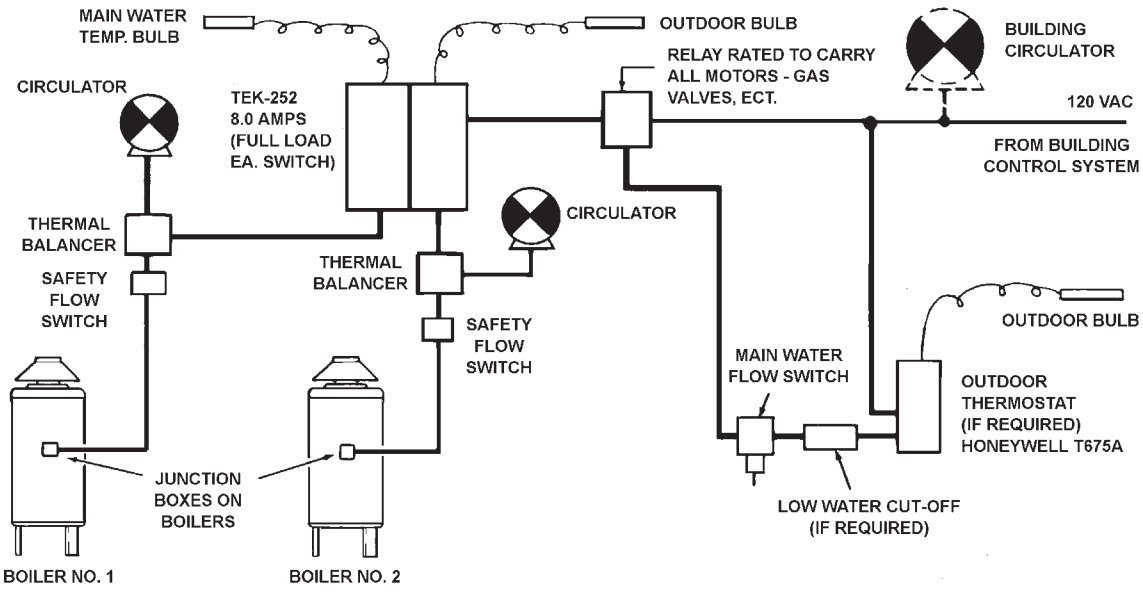


NOTE:

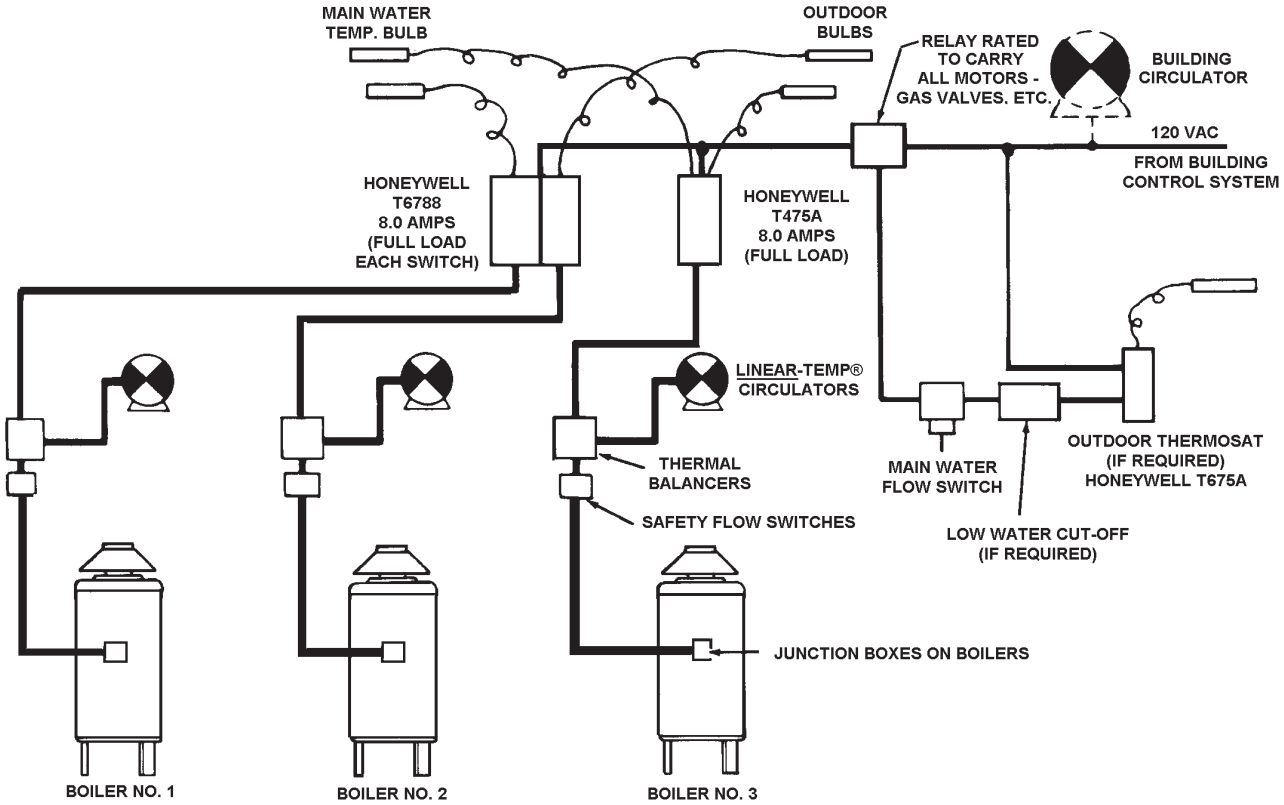
1. Building temperature controls supply electric power to building circulator.
2. Main flow switch proves main water flow before energizing sequencing and resetting controls.
3. Outdoor thermostat required if building controls do not provide automatic shutdown of reset controls during warm weather.

Boilers and Secondary Circulator are Controlled by

- Dual Bulb, Dual Switch Controller

Staging and Outdoor Reset of Main Water Temperature

CONTROL APPLICATION DIAGRAM - TWO BOILER LINEAR-TEMP® INSTALLATION WITH TWO CIRCULATORS
FIGURE 13


MAIN WATER TEMP. BULB
OUTDOOR BULBS
RELAY RATED TO CARRY ALL MOTORS - GAS VALVES. ETC.
BUILDING CIRCULATOR
120 VAC
FROM BUILDING CONTROL SYSTEM
HONEYWELL T6788 8.0 AMPS (FULL LOAD EACH SWITCH)
HONEYWELL T475A 8.0 AMPS (FULL LOAD)
LINEAR-TEMP® CIRCULATORS
THERMAL BALANCERS
SAFETY FLOW SWITCHES
MAIN WATER FLOW SWITCH
OUTDOOR THERMOSAT (IF REQUIRED) HONEYWELL T675A
LOW WATER CUT-OFF (IF REQUIRED)
JUNCTION BOXES ON BOILERS
BOILER NO. 1
BOILER NO. 2
BOILER NO. 3

NOTE:

1. Building temperature controls supply electric power to building circulator.
2. Main flow switch proves main water flow before energizing sequencing and resetting controls.
3. Outdoor thermostat required if building controls do not provide automatic shutdown of reset controls during warm weather.

Boilers and Secondary Circulator are Controlled by

- One Dual Bulb, Dual Switch Mechanical Controller and
- One Dual Bulb, single Switch Mechanical Controller

Sequencing and Outdoor Reset of Main Water Temperature.

CONTROL APPLICATION DIAGRAM - THREE BOILER LINEAR-TEMP® INSTALLATION WITH THREE CIRCULATORS
FIGURE 14

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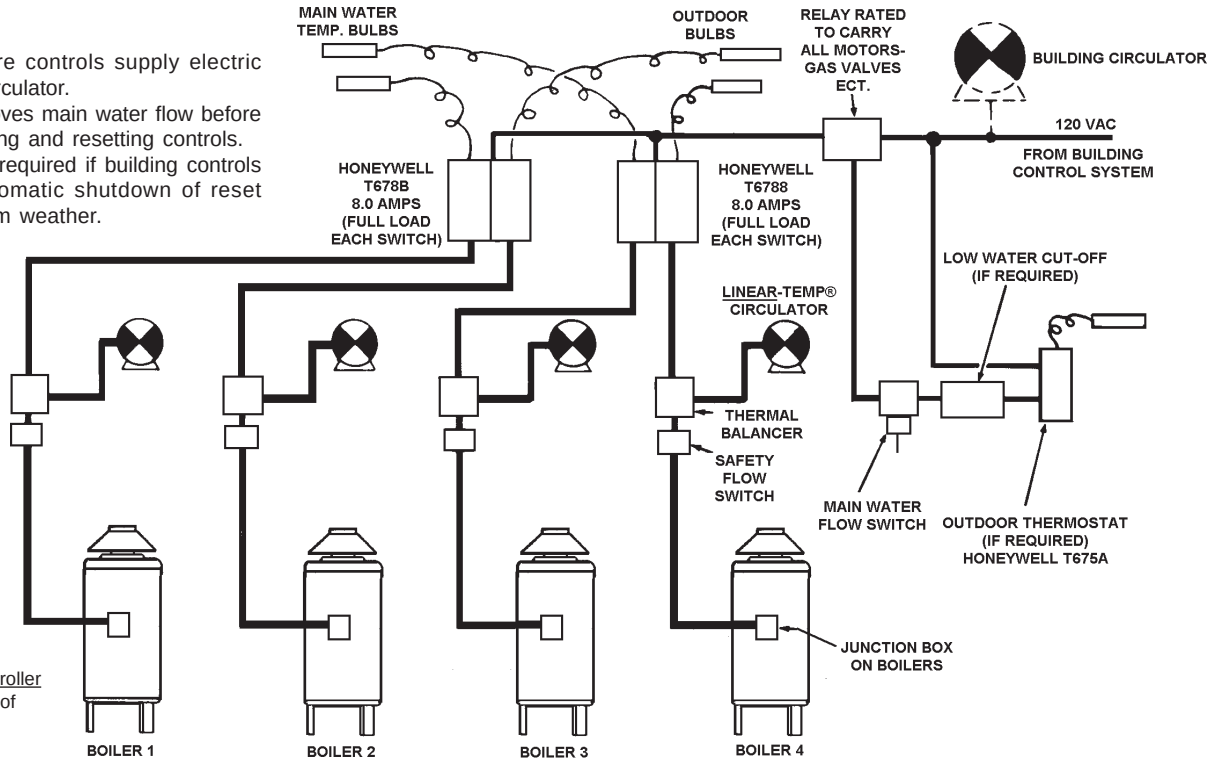
NOTE:

1. Building temperature controls supply electric power to building circulator.
2. Main flow switch proves main water flow before energizing sequencing and resetting controls.
3. Outdoor thermostat required if building controls do not provide automatic shutdown of reset controls during warm weather.

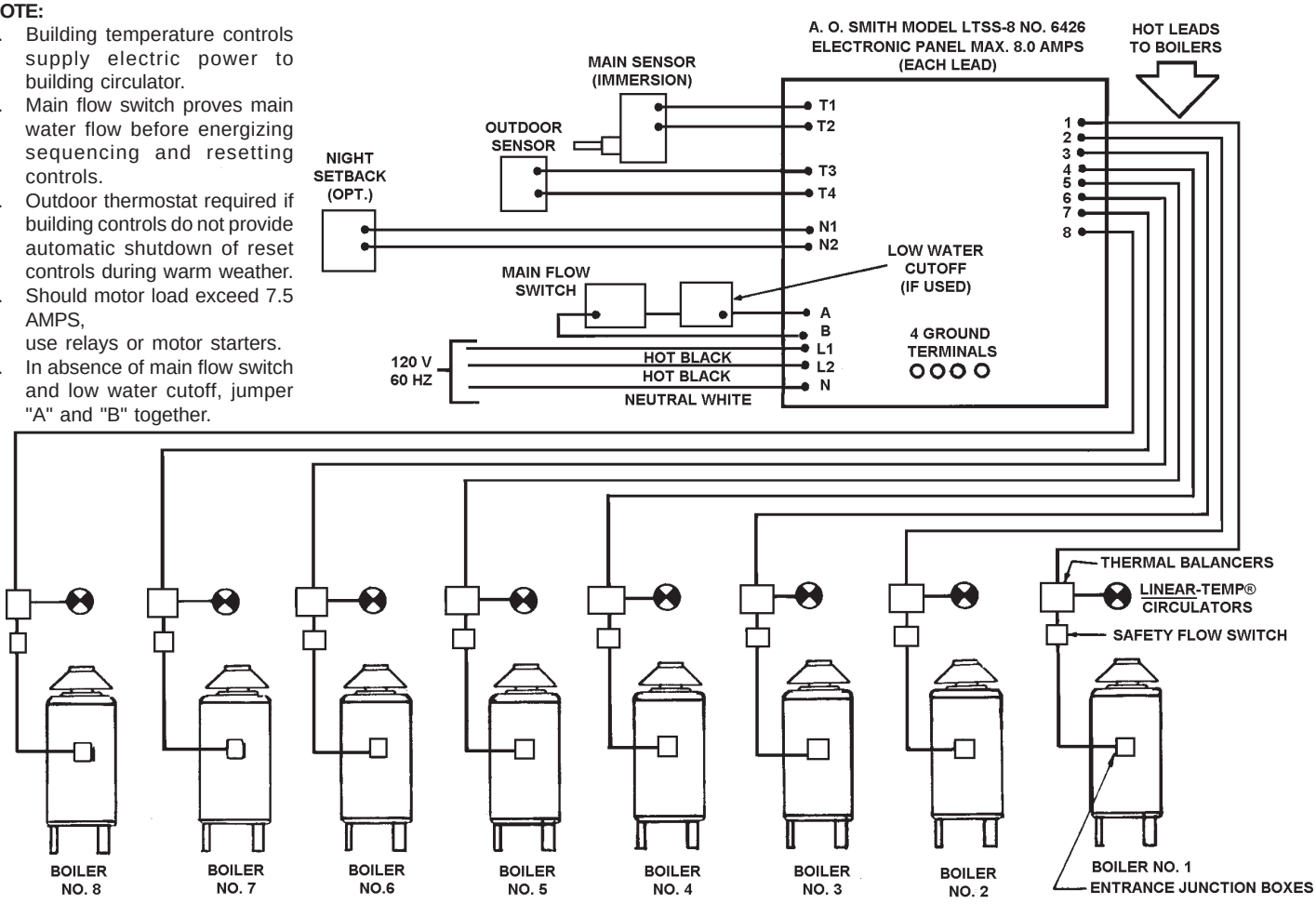


Boilers and Secondary Circulator are Controlled by Dual Bulb, Dual Switch Controller Staging and Outdoor Reset of Main Water Temperature

CONTROL APPLICATION DIAGRAM - FOUR BOILER LINEAR-TEMP® INSTALLATION WITH TWO CIRCULATORS
FIGURE 15

NOTE:

1. Building temperature controls supply electric power to building circulator.
2. Main flow switch proves main water flow before energizing sequencing and resetting controls.
3. Outdoor thermostat required if building controls do not provide automatic shutdown of reset controls during warm weather.
4. Should motor load exceed 7.5 AMPS, use relays or motor starters.
5. In absence of main flow switch and low water cutoff, jumper "A" and "B" together.



Boilers and Secondary Circulator areControlled by Dual Bulb, Dual Switch Controller Staging and Outdoor Reset of Main Water Temperature

CONTROL APPLICATION DIAGRAM - EIGHT BOILER LINEAR-TEMP® INSTALLATION WITH INDIVIDUAL CIRCULATORS
FIGURE 16

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CER-TEMP 80 - 1 UNIT INSTALLATION - FOR HOT WATER SUPPLY APPLICATION

CANADIAN MODELS, JUNCTION BOX W/6 TERMINALS

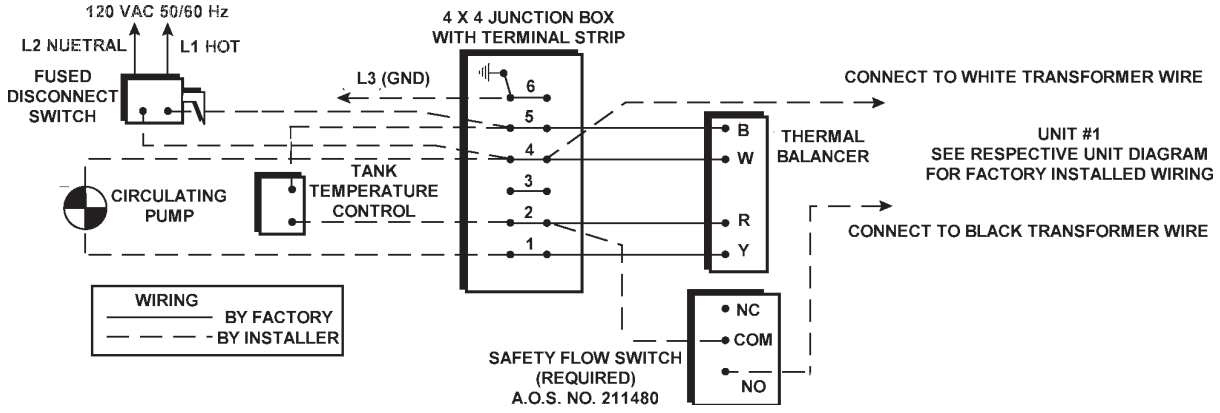


FIGURE 17

CER-TEMP 80 - 1 UNIT INSTALLATION - FOR HOT WATER SUPPLY APPLICATION

U.S. MODELS, JUCNTION BOX W/4 TERMINALS

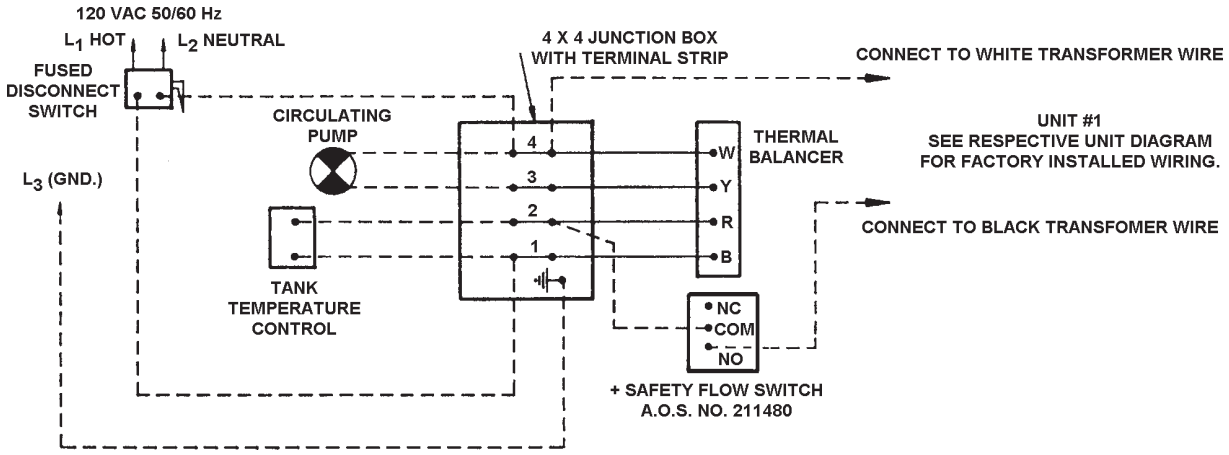
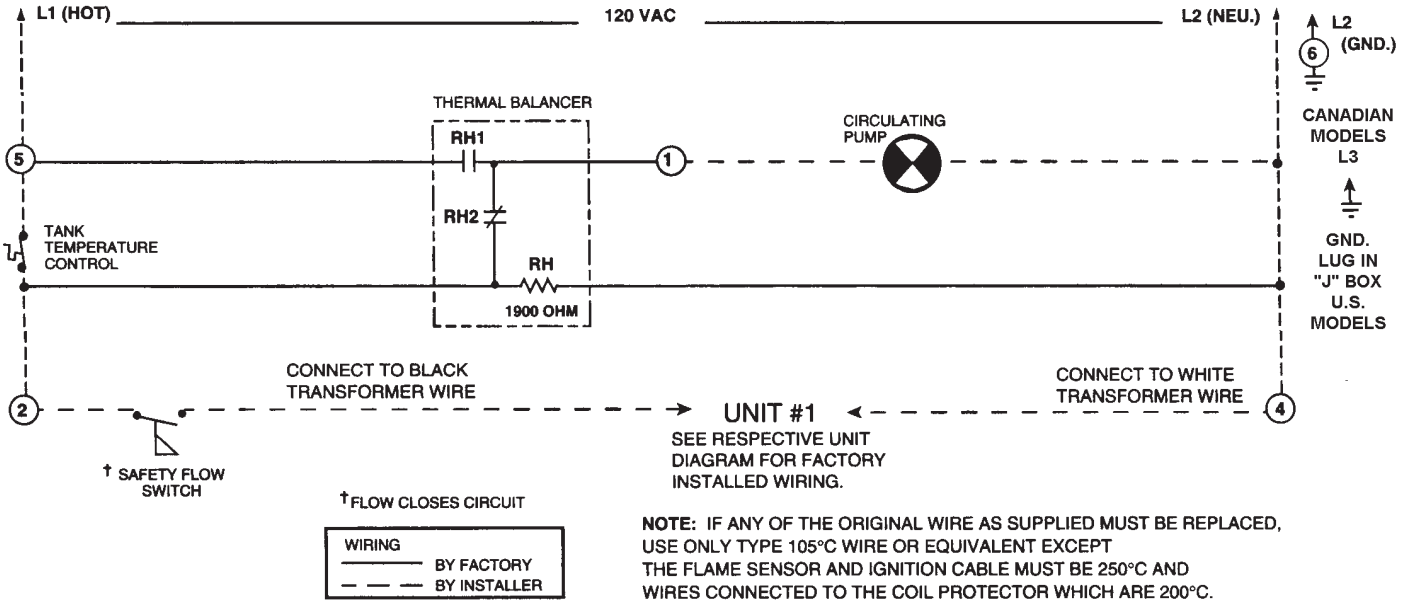


FIGURE 18

SCHEMATIC



NOTE: IF ANY OF THE ORIGINAL WIRE AS SUPPLIED MUST BE REPLACED, USE ONLY TYPE 105°C WIRE OR EQUIVALENT EXCEPT THE FLAME SENSOR AND IGNITION CABLE MUST BE 250°C AND WIRES CONNECTED TO THE COIL PROTECTOR WHICH ARE 200°C.

FIGURE 19

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CER-TEMP 80 - 2 OR 3 UNIT INSTALLATION - FOR HOT WATER SUPPLY APPLICATION

CANADIAN MODELS, JUNCTION BOX W/6 TERMINALS

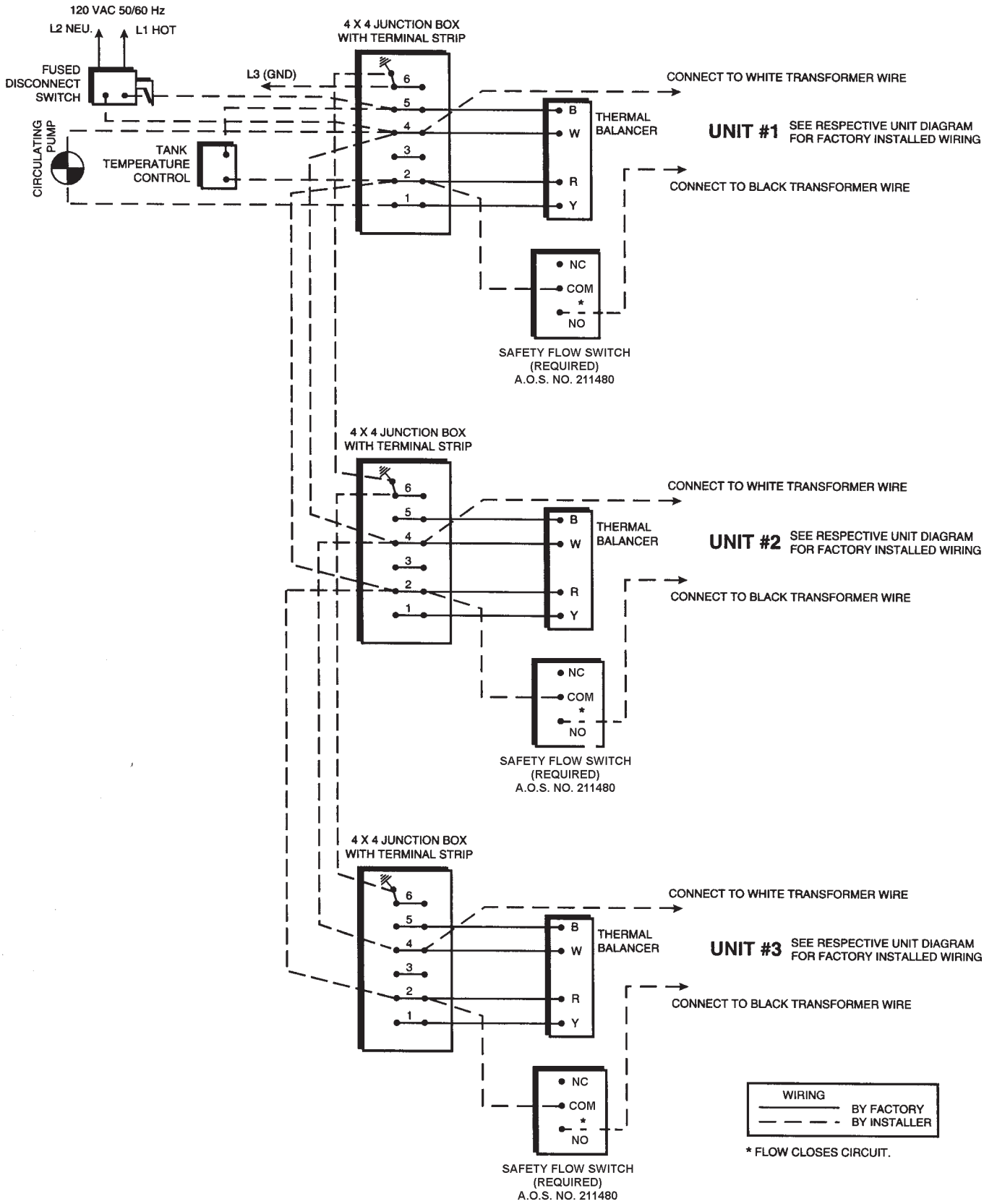

FIGURE 20

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SCHEMATIC

CANADIAN MODELS, JUNCTION BOX W/6 TERMINALS

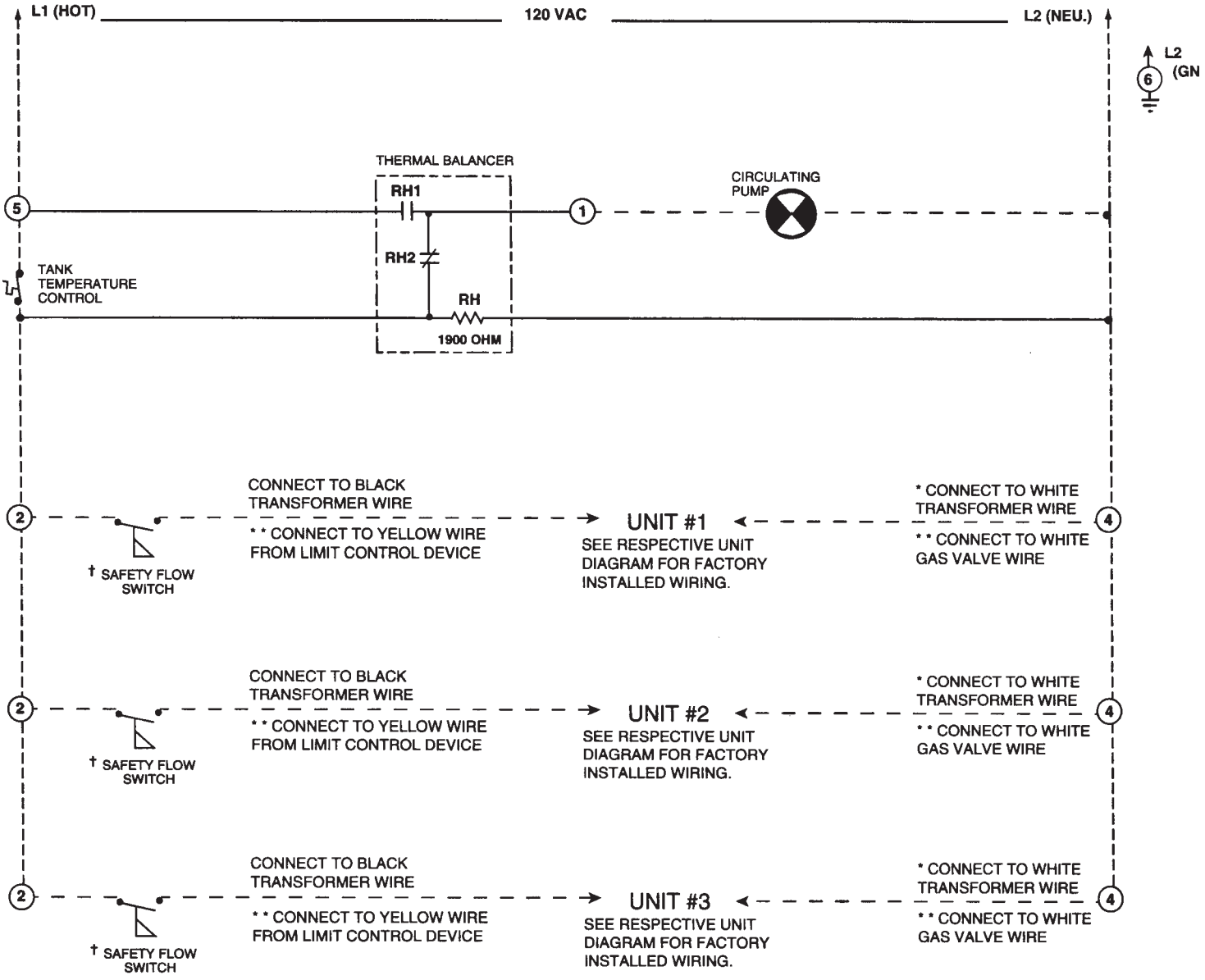

FIGURE 21

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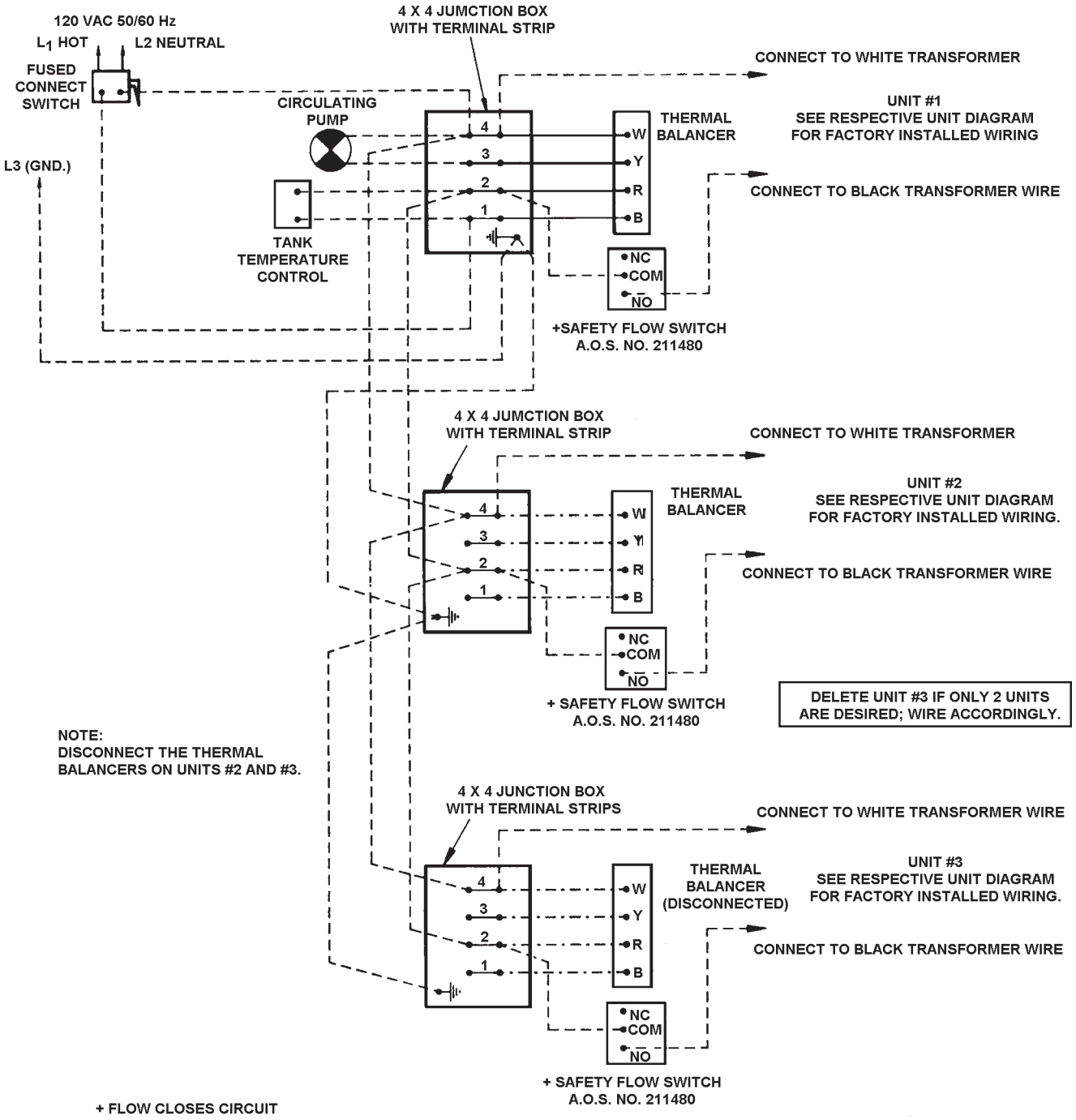
CER-TEMP 80 - 2 OR 3 UNIT INSTALLATION CONNECTION DIAGRAM (FOR HOT WATER SUPPLY APPLICATION)

U.S. MODELS, JUNCTION BOX W/4 TERMINALS


120 VAC 50/60 Hz
L1 HOT
L2 NEUTRAL
FUSED CONNECT SWITCH
L3 (GND.)
4 X 4 JUMCTION BOX WITH TERMINAL STRIP
CIRCULATING PUMP
TANK TEMPERATURE CONTROL
CONNECT TO WHITE TRANSFORMER
UNIT #1
SEE RESPECTIVE UNIT DIAGRAM FOR FACTORY INSTALLED WIRING
THERMAL BALANCER
CONNECT TO BLACK TRANSFORMER WIRE
NC
COM
NO
+SAFETY FLOW SWITCH A.O.S. NO. 211480
4 X 4 JUMCTION BOX WITH TERMINAL STRIP
CONNECT TO WHITE TRANSFORMER
UNIT #2
SEE RESPECTIVE UNIT DIAGRAM FOR FACTORY INSTALLED WIRING.
THERMAL BALANCER
CONNECT TO BLACK TRANSFORMER WIRE
+ SAFETY FLOW SWITCH A.O.S. NO. 211480
DELETE UNIT #3 IF ONLY 2 UNITS ARE DESIRED; WIRE ACCORDINGLY.
NOTE:
DISCONNECT THE THERMAL BALANCERS ON UNITS #2 AND #3.
4 X 4 JUNCTION BOX WITH TERMINAL STRIPS
CONNECT TO WHITE TRANSFORMER WIRE
UNIT #3
SEE RESPECTIVE UNIT DIAGRAM FOR FACTORY INSTALLED WIRING.
THERMAL BALANCER (DISCONNECTED)
CONNECT TO BLACK TRANSFORMER WIRE
+ SAFETY FLOW SWITCH A.O.S. NO. 211480
+ FLOW CLOSES CIRCUIT
WIRING
BY FACTORY
BY INSTALLER
DISCONNECT

NOTE:
IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITH THE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE 105°C WIRE OR ITS EQUIVALENT, EXCEPT FOR THE FLAME SENSOR AND IGNITION CABLE (I.I.D. UNITS ONLY) WHICH ARE 250°C AND WIRES CONNECTED TO THE COIL PROTECTOR WHICH ARE 200°C.

FIGURE 22

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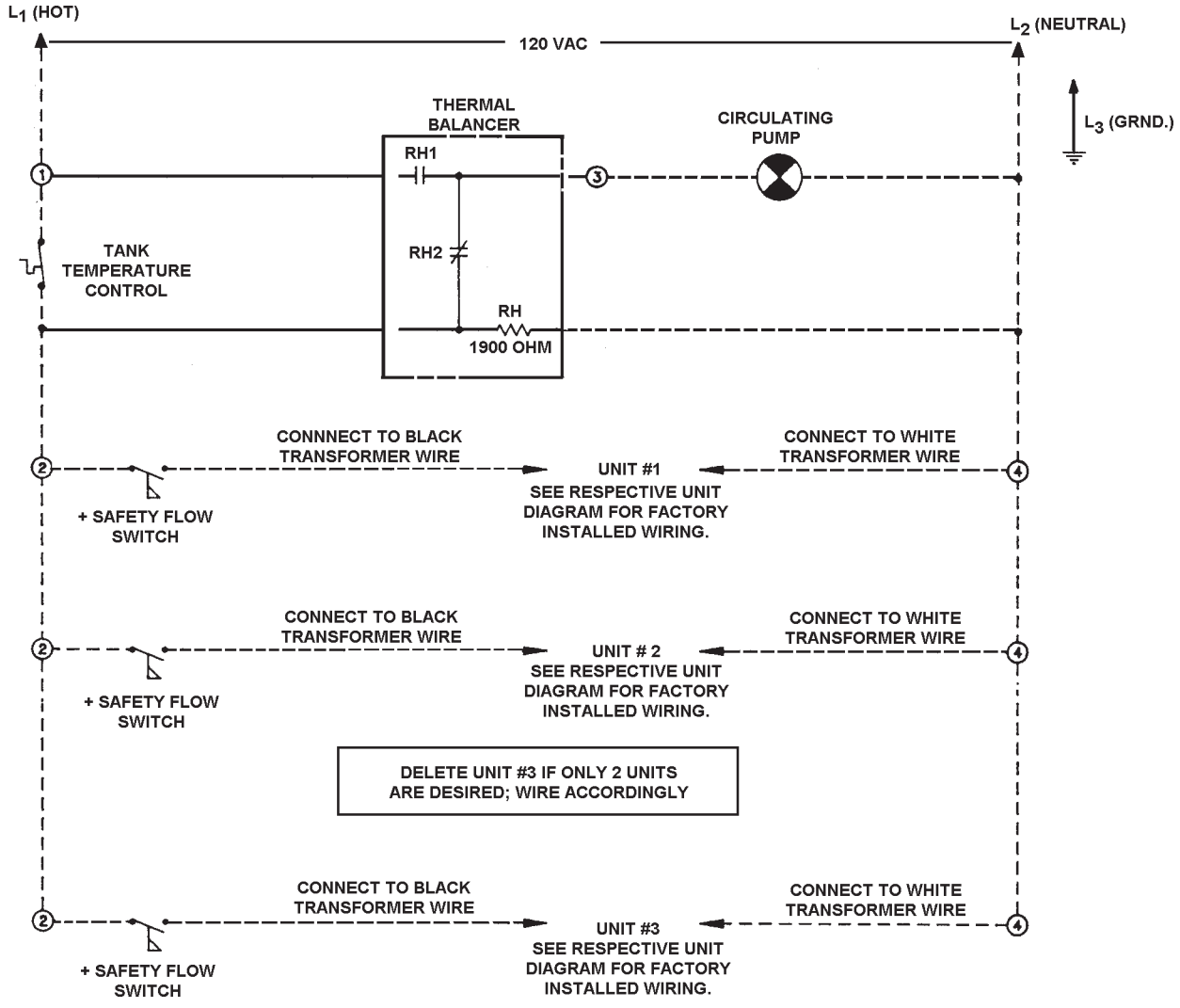
CER-TEMP 80 - 2 OR 3 UNIT INSTALLATION SCHEMATIC DIAGRAM (FOR HOT WATER SUPPLY APPLICATION)

U.S. MODELS, JUNCTION BOX W/4 TERMINALS



+ FLOW CLOSES CIRCUIT

WIRING

——— BY FACTORY

– – – – – – BY INSTALLER

NOTE:
IF ANY OF THE ORIGINAL WIRE, AS SUPPLIED WITHTHE APPLIANCE, MUST BE REPLACED, IT MUST BE REPLACED WITH TYPE 105°C WIRE OR EQUIVALENT, EXCEPT FOR THE FLAME SENSOR AND IGNITION CABLE (I.I.D. UNITS ONLY) WHICH ARE 250°C AND WIRES CONNECTED TO THE COIL PROTECTOR WHICH ARE 200°C.

FIGURE 23

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BOOSTER - RECOVERY WIRING DIAGRAM

CANADIAN MODELS, JUNCTION BOX W/6 TERMINALS

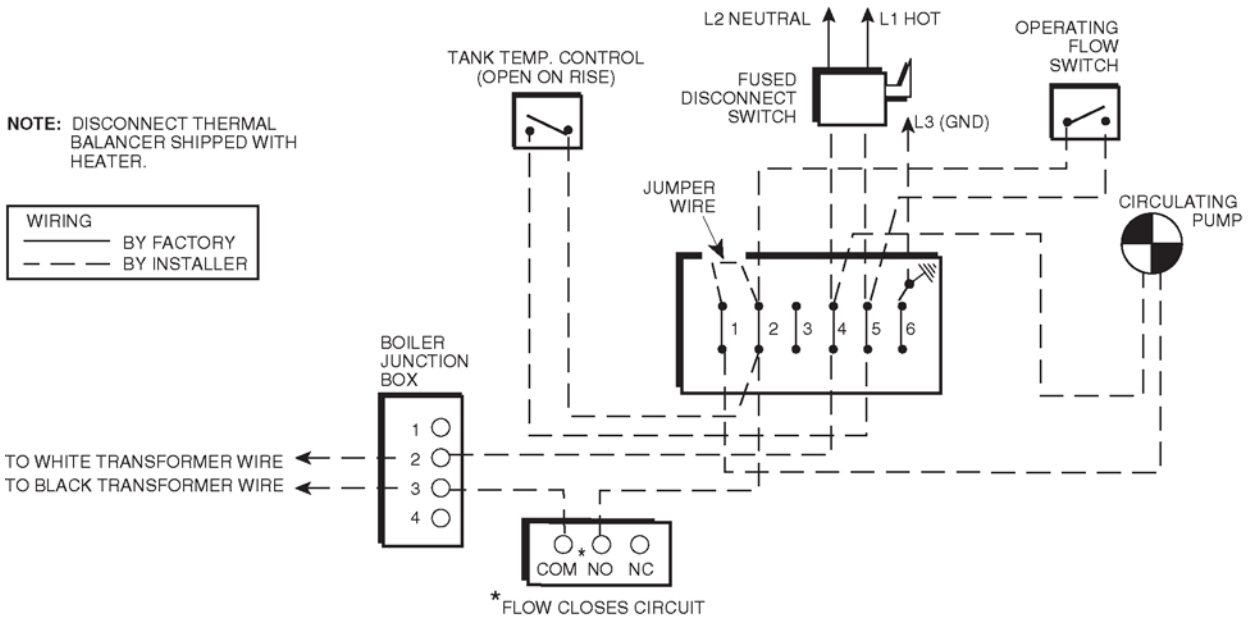

FIGURE 24

SHURE-TEMP BOOSTER - RECOVERY WIRING DIAGRAM (TWO TEMPERATURE SYSTEM)

CANADIAN MODELS, JUNCTION BOX W/6 TERMINALS

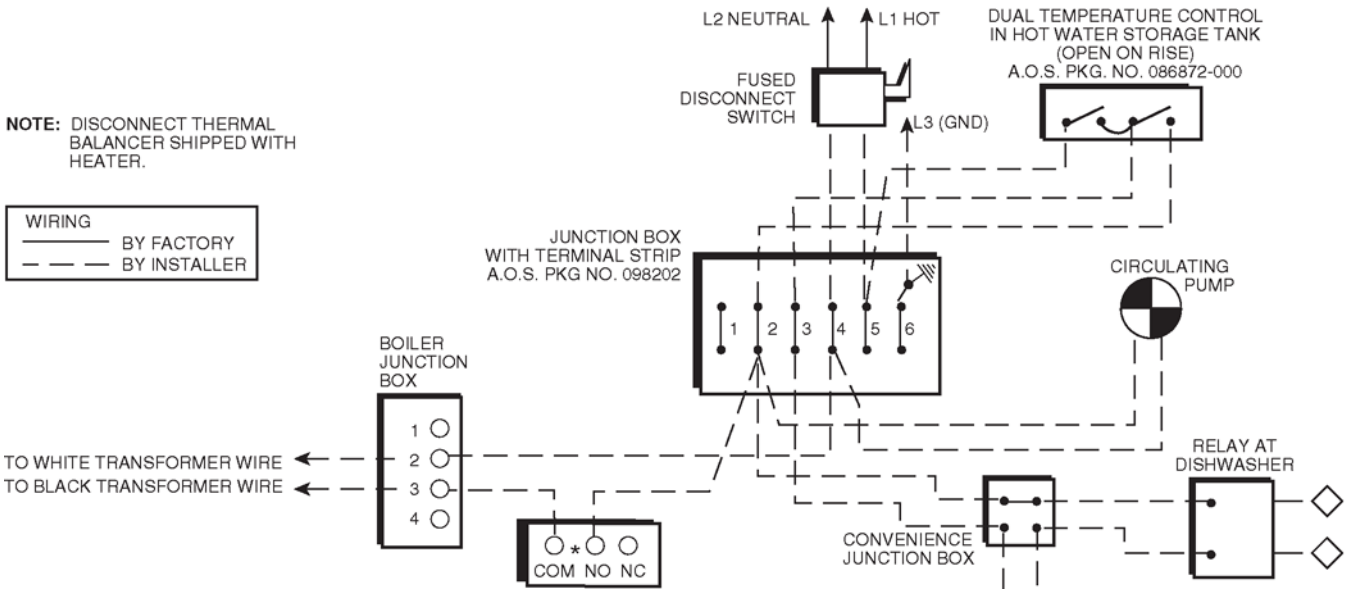

FIGURE 25

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BOOSTER - RECOVERY WIRING DIAGRAM

U.S. MODELS, JUNCTION BOX W/4 TERMINALS

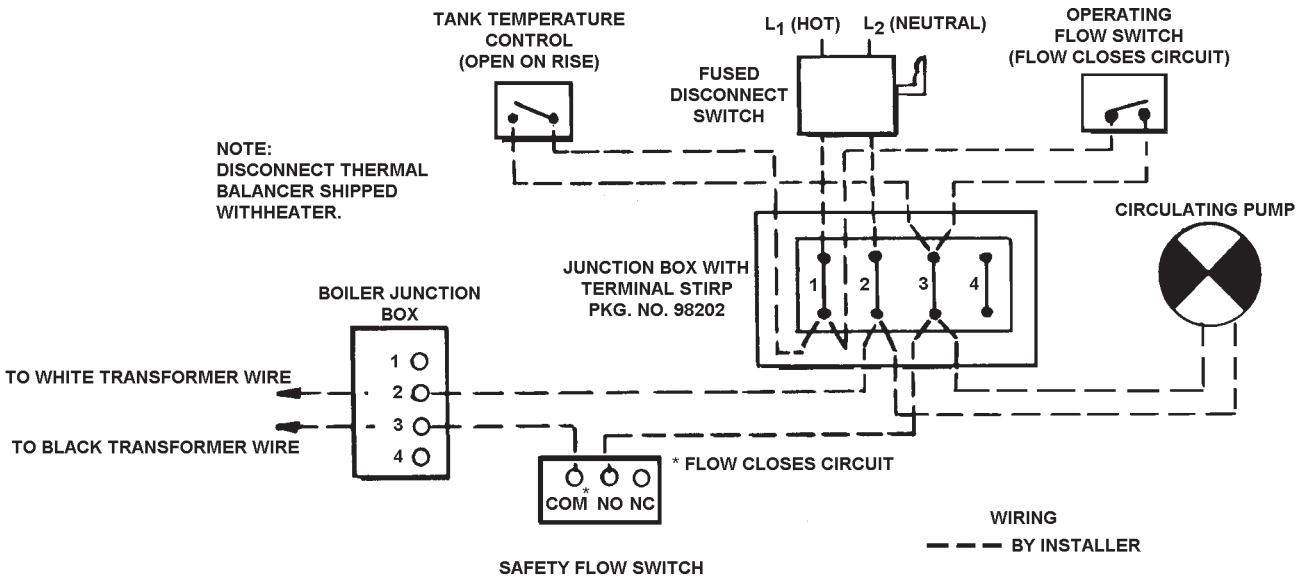

FIGURE 26

SHURE - TEMP BOOSTER - RECOVERY WIRING DIAGRAM
TWO-TEMPERATURE SYSTEM

U.S. MODELS, JUNCTION BOX W/4 TERMINALS

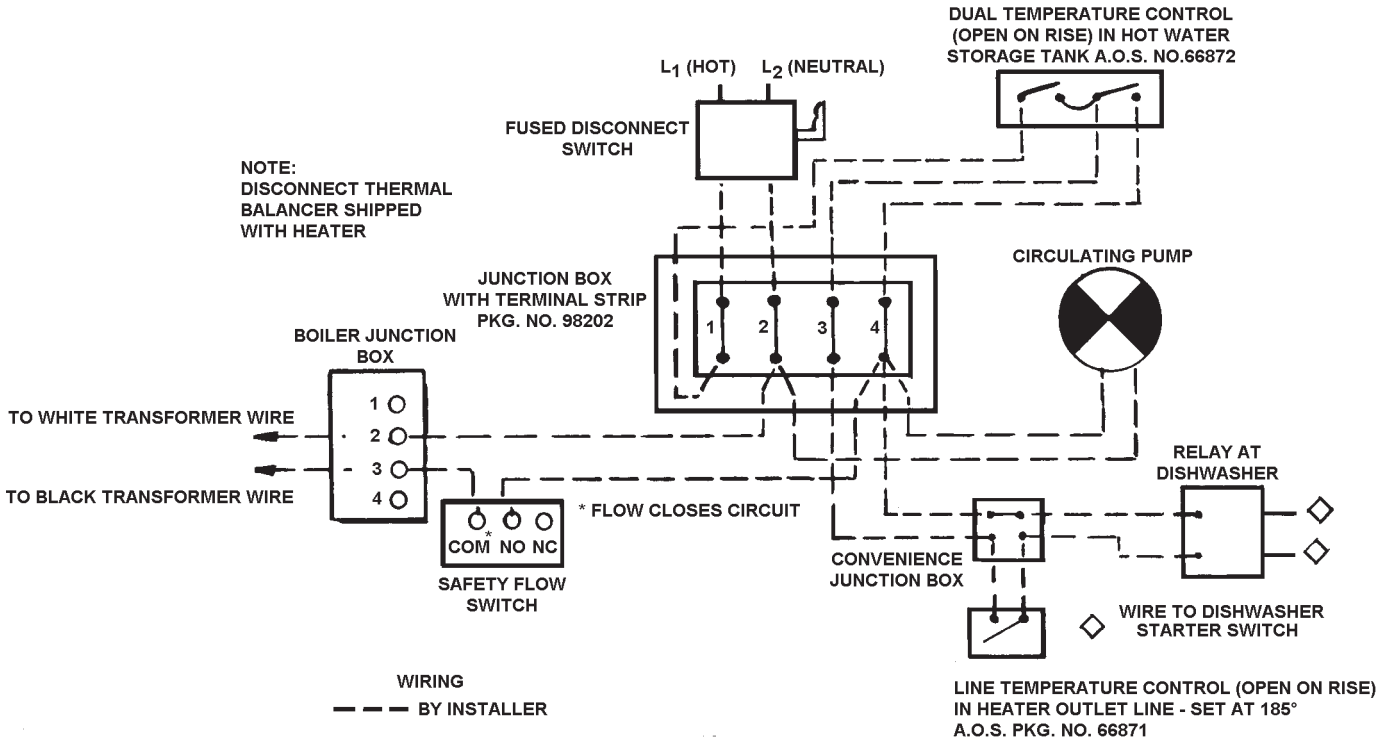
DUAL TEMPERATURE CONTROL (OPEN ON RISE) IN HOT WATER STORAGE TANK A.O.S. NO.66872
L1 (HOT) L2 (NEUTRAL)
FUSED DISCONNECT SWITCH
NOTE: DISCONNECT THERMAL BALANCER SHIPPED WITH HEATER
CIRCULATING PUMP
JUNCTION BOX WITH TERMINAL STRIP PKG. NO. 98202
1 2 3 4
BOILER JUNCTION BOX
TO WHITE TRANSFORMER WIRE
TO BLACK TRANSFORMER WIRE
* FLOW CLOSES CIRCUIT
COM NO NC
SAFETY FLOW SWITCH
RELAY AT DISHWASHER
CONVENIENCE JUNCTION BOX
WIRE TO DISHWASHER STARTER SWITCH
WIRING
BY INSTALLER
LINE TEMPERATURE CONTROL (OPEN ON RISE) IN HEATER OUTLET LINE - SET AT 185° A.O.S. PKG. NO. 66871

FIGURE 27

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WATER LINE CONNECTIONS

This section provides detailed installation diagrams for typical methods of application for the unit using a Cer-Temp 80 Recovery System (for one temperature water), and either Booster-Recovery or the Shure-Temp Booster-Recovery System (for two temperature water).

These diagrams will serve to provide the installer with a reference for the materials and methods of piping necessary for installation. It is essential that all water and gas piping, vent connections, electrical wiring, and check and flow regulating valves be installed as shown on the diagrams.

Consult the installation diagrams for appropriate locations to install the safety flow switch(es), drain valves, thermometers, relief valves and the circulating pump(s). Apply suitable pipe thread sealing compounds to only the male threads of parts to be connected. If any of these parts are being replaced in a functioning system, remember to shut off the manual gas and control valve(s) and close off the water inlet(s). Open a nearby faucet to relieve pressure and/or drain the boiler or system before attempting to install the new parts.

Check the diagrams thoroughly before starting installation to avoid errors and minimize time and materials cost.

If the system is to be filled with water for testing or other purposes during cold weather and before actual operation, care must be taken to prevent a downdraft entering the boiler or freezing air from contacting the system. Failure to do so may cause the water in the system to freeze with resulting damage to the system. Damage due to freezing is not covered by the warranty.

This equipment must be protected against loss of water or loss of water flow by the installation of a safety flow switch in the outlet piping from the boiler. Piping and wiring diagrams show the application of the accessory package for this purpose.

HARD WATER

Where hard water conditions exist, water softening or the threshold type of water treatment is recommended. This will protect the dishwashers, coffee urns, water boilers, water piping and other equipment. When water softening or water treatment is not practical, a comparatively easy method of periodic lime removal from the boiler may be employed by installing gate valves, drain valve and acid fill opening as shown in CLEANING AND FLUSHING section of this manual.

TANK TEMPERATURE CONTROL

The water temperature in the storage tank is controlled by the Tank Temperature Control. The sensing element is mounted inside the hot water storage tank, see fig's. 31-38.

⚠ DANGER

HOT WATER TEMPERATURES REQUIRED FOR AUTOMATIC DISHWASHER AND LAUNDRY USE CAN CAUSE SCALD BURNS RESULTING IN SERIOUS PERSONAL INJURY AND/OR DEATH. THE TEMPERATURE AT WHICH INJURY OCCURS VARIES WITH THE PERSON'S AGE AND TIME OF EXPOSURE. THE SLOWER RESPONSE TIME OF CHILDREN, AGED OR DISABLED PERSONS INCREASES THE HAZARDS TO THEM. NEVER ALLOW SMALL CHILDREN TO USE A HOT WATER TAP, OR TO DRAW THEIR OWN BATH WATER. NEVER LEAVE A CHILD OR DISABLED PERSON UNATTENDED IN A BATHTUB OR SHOWER.

The tank temperature control is adjustable from 100°F (37.7°C) to 220°F (104.4°C). It is recommended that lower water temperatures be used to avoid the risk of scalding. It is further recommended, in all cases, that the water temperature be set for the lowest temperature which satisfies the user's hot water needs. This will also provide the most energy efficient operation of the water heater and minimize scale formation.

THE WATER HEATER SHOULD BE LOCATED IN AN AREA WHERE THE GENERAL PUBLIC DOES NOT HAVE ACCESS TO SET TEMPERATURES. SETTING THE WATER TEMPERATURE AT 120°F (49°C) WILL REDUCE THE RISK OF SCALDS. Some states or provinces require settings at specific lower temperatures. Below you will find listed the approximate time-to-burn relationship for normal adult skin. Valves for reducing point-of-use temperature by mixing cold and hot water are available. Also available are inexpensive devices that attach to faucets to limit hot water temperatures. Contact a licensed plumber or the local plumbing authority.

DETAIL OF TANK FITTING USED WITH MODIFIED RECOVERY AND BOOSTER RECOVERY PIPING DIAGRAMS

WHERE HORIZONTAL TANK USED IS NOT OF A.O. SMITH MANUFACTURE

PARTS ORDER DATA

PACKAGE NO.	FITTING
94447	2"
94447-1	2-1/2"
94447-2	3"
94447-3	1-1/2"

(WHEN ORDERING TANK FITTINGS, SPECIFY PACKAGE NO.)

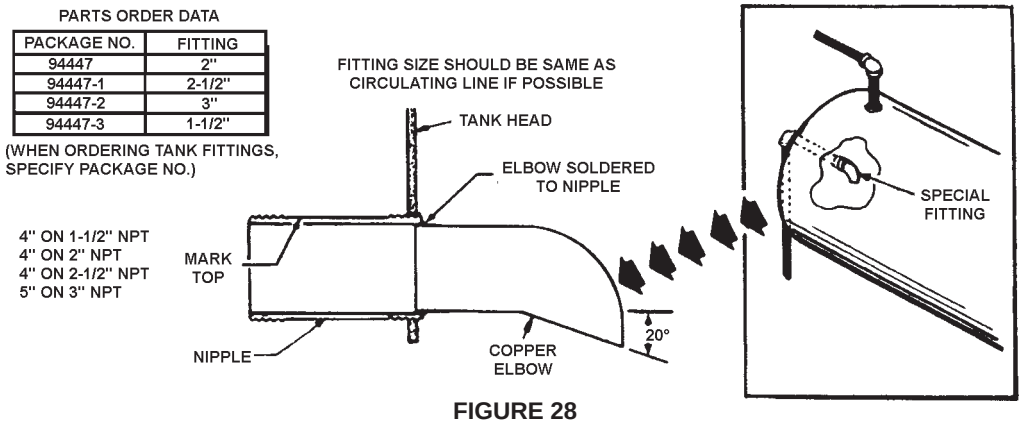

FIGURE 28

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Temperature Setting	Time to Produce 2nd & 3rd Degree Burns on Adult Skin
OVER: 170°F (77°C)	Nearly instantaneous
160°F (71°C)	About 1/2 second
150°F (65°C)	About 1-1/2 seconds
140°F (60°C)	Less than 5 seconds
130°F (54°C)	About 30 seconds
120°F (49°C)	More than 5 minutes

USE ANTI-SCALD VALVE(S) in the hot water system to reduce the risks of scalds at points of use such as lavatories, sinks and bathing facilities.

A change in water temperature in the storage tank lower than the Tank Temperature Control setting will cause the sensor to close its contacts and consequently energize the boiler.

If the Tank Temperature Control is out of calibration, replace it with a new one; do not attempt to fix this control.

WARNING

SHOULD OVERHEATING OCCUR OR THE GAS SUPPLY FAIL TO SHUT OFF, TURN OFF THE MANUAL GAS CONTROL VALVE TO THE APPLIANCE.

LOW WATER CUTOFF

A low water cutoff is a safety device which is installed in the boiler piping to prevent the boiler from firing in the event of inadequate water levels in the boiler system.

Where required by local code, this optional device is to be installed in the boiler piping at a level above that of the heat exchanger.

A float type or an electronic probe type low water cutoff may be used. The manufacturer's installation instructions must be followed.

THERMOMETERS

Thermometers should be obtained and field installed as shown in the installation diagrams.

Thermometers are installed in the system as a means of detecting a possible liming condition in the boiler. An increase of 3°C (5°F) over the normal temperature rise through the boiler is an indication that lime is present. The term "temperature rise" designates the difference between the boiler inlet and outlet water temperature.

An increase of 3°C (5°F) above the recorded temperature rise may signify a liming condition in the coils or heat exchanger. Refer to CLEANING AND FLUSHING section of this manual for deliming instructions.

Record temperature rise at initial start-up for future reference.

DRAIN VALVE (Not Supplied)

A drain valve must be obtained and installed on each boiler and tank for draining purposes, see installation diagrams in this manual.

CLOSED WATER SYSTEM

This boiler should not be installed in a closed water system without taking steps to reduce excessive system pressure due to thermal expansion. Contact the water supplier or local plumbing inspector on how to control this situation.

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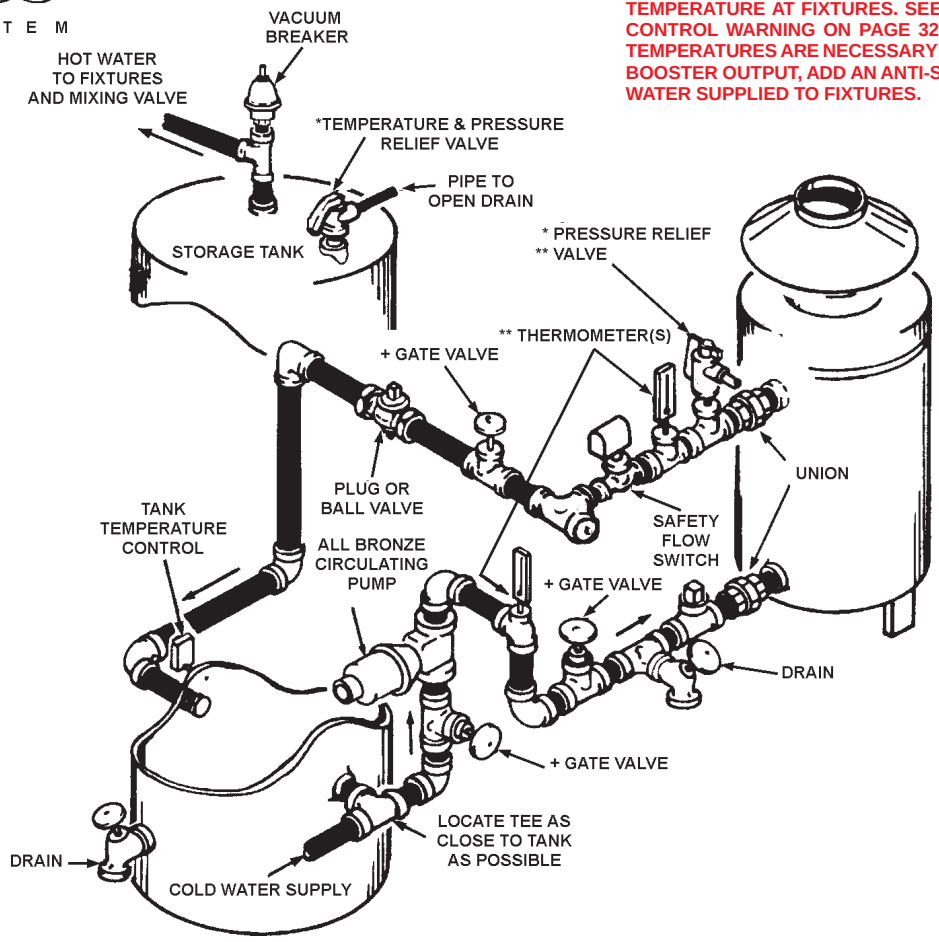
ONE HW-300, HW-399, HW-420, HW-520, HW-610 OR ONE HW-670 UP-FLOW MODEL COMMERCIAL BOILER WITH VERTICAL TANK

A.O. SMITH Cer-Temp 80® RECOVERY SYSTEM

⚠ DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 32. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.



IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE (A.O. SMITH PKG. NO. 211480).

\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.

USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

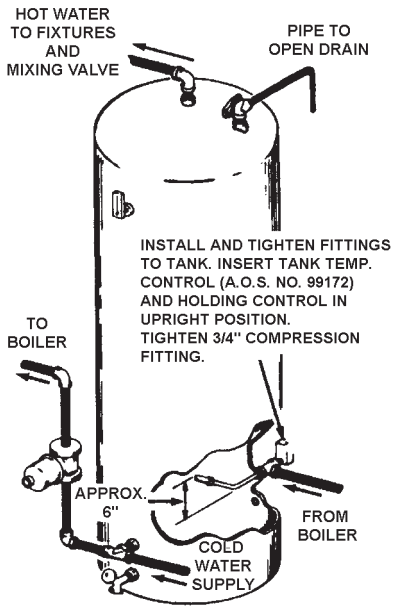
Model Number	Minimum Pipe Size (Inches)	B & G Pump Size	*Armstrong Pump Size
HW-300	1-1/4"	125	S-25 1-1/4"
HW-399	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-420	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-520	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-610/670	2"	2"	S-35

*Assumes 50 equivalent feet pf piping or less.

WIRING - FIGURES 17, 18, 19

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

MODIFIED VERSION USING OTHER THAN A.O. SMITH STORAGE TANK


HOT WATER TO FIXTURES AND MIXING VALVE
PIPE TO OPEN DRAIN
INSTALL AND TIGHTEN FITTINGS TO TANK. INSERT TANK TEMP. CONTROL (A.O.S. NO. 99172) AND HOLDING CONTROL IN UPRIGHT POSITION. TIGHTEN 3/4" COMPRESSION FITTING.
TO BOILER
APPROX. 6"
FROM BOILER
COLD WATER SUPPLY

IF CIRCULATING LOOP IS USED, CONNECT RETURN LINE TO DRAIN CONNECTION AT TANK.

FIGURE 29

Downloaded from www.Manualslib.com manuals search engine

ONE HW-300, HW-399, HW-420, HW-520, HW-610 OR ONE HW-670 UP-FLOW MODEL COMMERCIAL BOILER WITH HORIZONTAL TANK

A.O. SMITH Cer-Temp 80® RECOVERY SYSTEM

⚠ DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 32. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

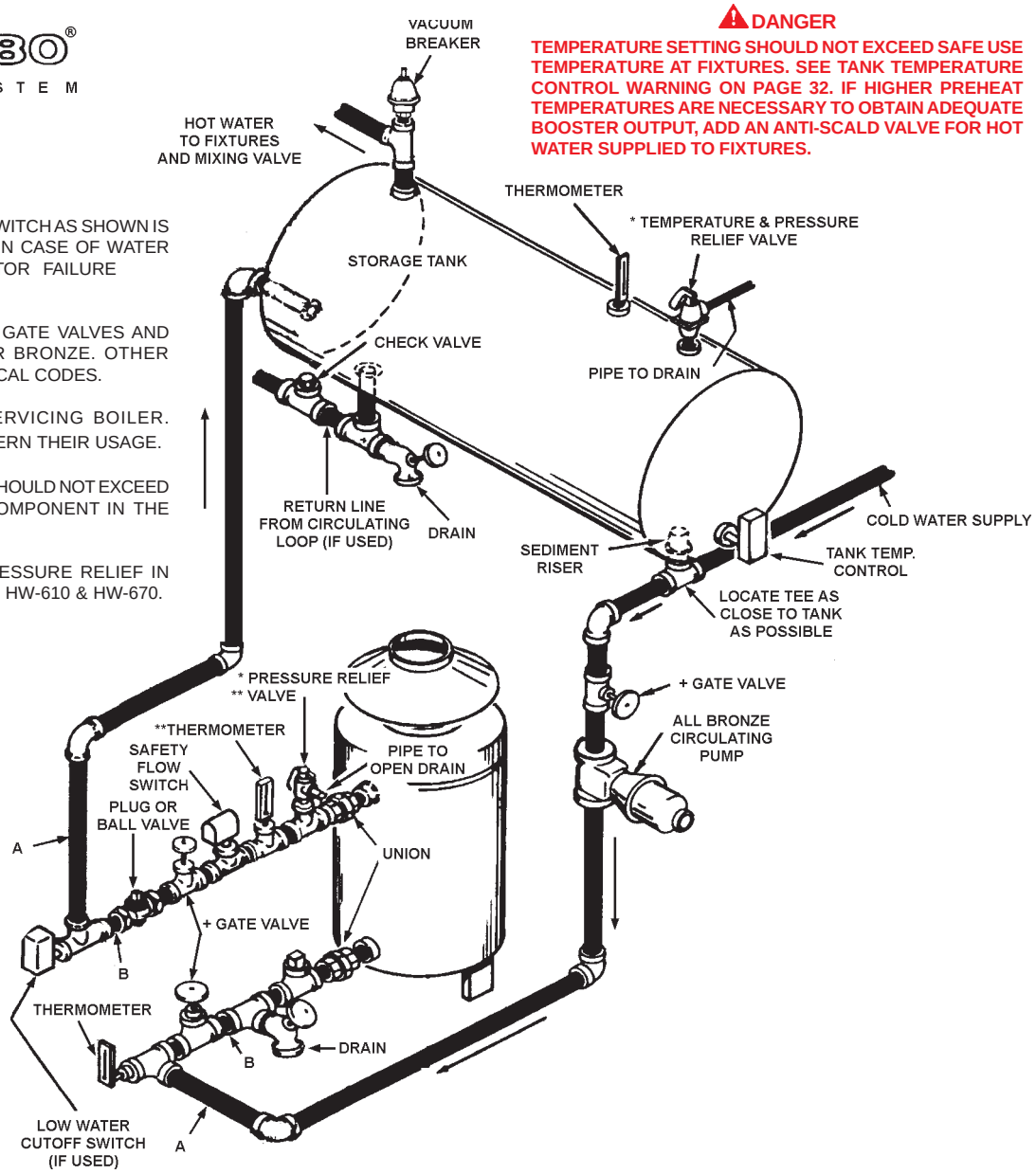
IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE (A.O. SMITH PKG. NO. 211480).

\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.



WIRING - FIGURES 17, 18, 19

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

Model Number	Minimum Pipe Size (Inches)	B & G Pump Size	*Armstrong Pump Size
HW-300	1-1/4"	125	S-25 1-1/4"
HW-399	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-420	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-520	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-610/670	2"	2"	S-35

*Assumes 50 equivalent feet pf piping or less.

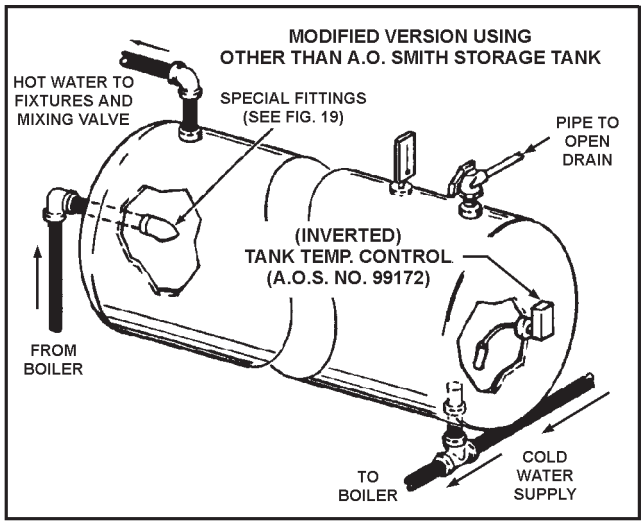

MODIFIED VERSION USING OTHER THAN A.O. SMITH STORAGE TANK
HOT WATER TO FIXTURES AND MIXING VALVE
SPECIAL FITTINGS (SEE FIG. 19)
PIPE TO OPEN DRAIN
(INVERTED) TANK TEMP. CONTROL (A.O.S. NO. 99172)
FROM BOILER
TO BOILER
COLD WATER SUPPLY

FIGURE 30

Downloaded from www.Manualslib.com manuals search engine

TWO HW-399's, HW-420's, HW-520's, HW-610's or HW-670's UP-FLOW MODEL COMMERCIAL BOILER WITH VERTICAL TANK, CER-TEMP 80

A.O. SMITH Cer-Temp 80® RECOVERY SYSTEM

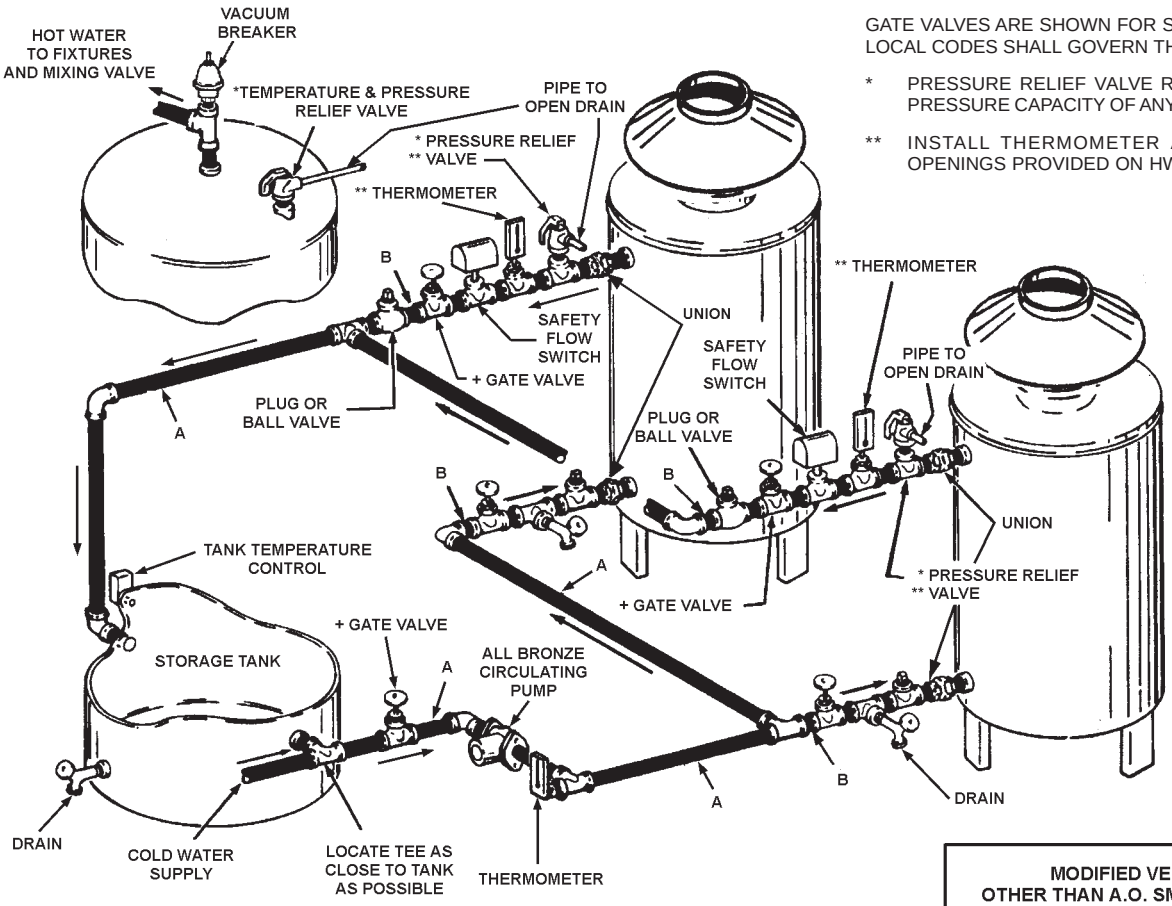
IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE (A.O. SMITH PKG. NO. 211480).

\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.



⚠ DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 32. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

WIRING - FIGURES 20, 21, 22, OR 23

HEATERS SPACED 30" APART

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

Model Number	MinimumPipe Size (Inches)		B & G Pump Size	*Armstrong Pump Size
	A	B		
HW-300	2"	1-1/2"	2"	S-35
HW-399	2"	1-1/2"	2"	S-35
HW-420	2"	1-1/2"	2"	S-35
HW-520	2"	1-1/2"	2"	S-35
HW-610/670	2-1/2"	1-1/2"	2-1/2"	S-45 2-1/2"

*Assumes 50 equivalent feet pf piping or less.

MODIFIED VERSION USING OTHER THAN A.O. SMITH STORAGE TANK

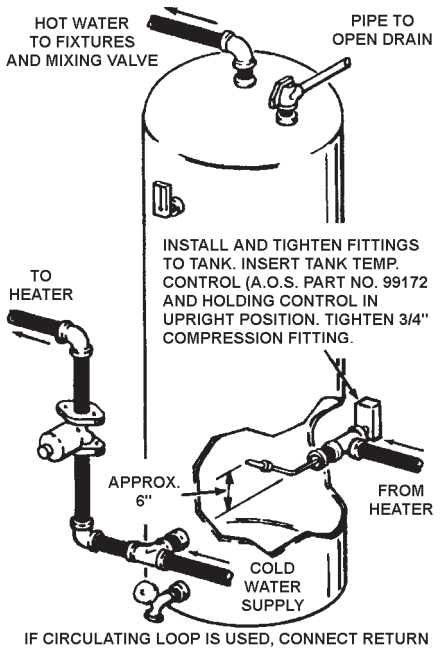

HOT WATER TO FIXTURES AND MIXING VALVE
PIPE TO OPEN DRAIN
INSTALL AND TIGHTEN FITTINGS TO TANK. INSERT TANK TEMP. CONTROL (A.O.S. PART NO. 99172 AND HOLDING CONTROL IN UPRIGHT POSITION. TIGHTEN 3/4" COMPRESSION FITTING.
TO HEATER
APPROX. 6"
FROM HEATER
COLD WATER SUPPLY
IF CIRCULATING LOOP IS USED, CONNECT RETURN LINE TO DRAIN CONNECTION AT TANK

FIGURE 31

Downloaded from www.Manualslib.com manuals search engine

TWO HW-300's, HW-399's, HW-420's, HW-520's, HW-610's OR HW-670's UP-FLOW MODEL COMMERCIAL BOILER WITH HORIZONTAL TANK

IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE (A.O. SMITH PKG. NO.211480).

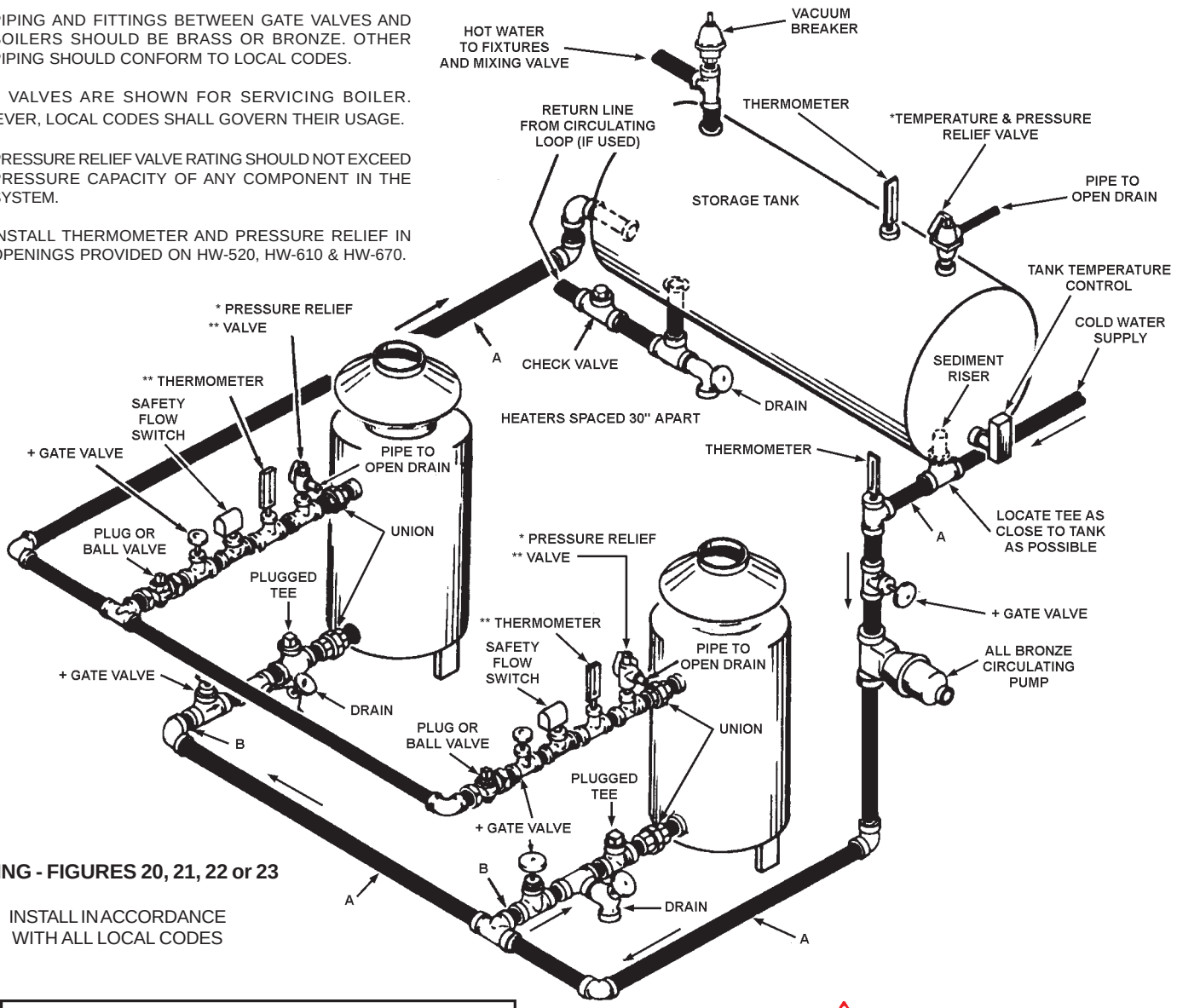
\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

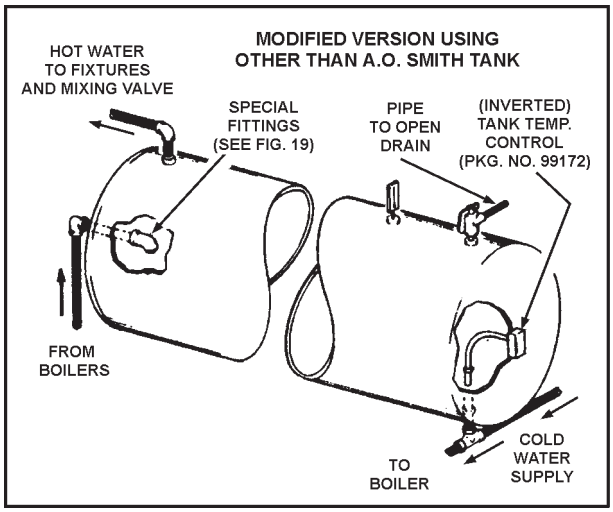
** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.

A.O. SMITH Cer-Temp 80® RECOVERY SYSTEM



WIRING - FIGURES 20, 21, 22 or 23

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES


MODIFIED VERSION USING OTHER THAN A.O. SMITH TANK
HOT WATER TO FIXTURES AND MIXING VALVE
SPECIAL FITTINGS (SEE FIG. 19)
PIPE TO OPEN DRAIN
(INVERTED) TANK TEMP. CONTROL (PKG. NO. 99172)
FROM BOILERS
TO BOILER
COLD WATER SUPPLY

⚠ DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 32. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

Model Number	MinimumPipe Size (Inches)		B & G Pump Size	*Armstrong Pump Size
	A	B		
HW-300	2"	1-1/2"	2"	S-35
HW-399	2"	1-1/2"	2"	S-35
HW-420	2"	1-1/2"	2"	S-35
HW-520	2"	1-1/2"	2"	S-35
HW-610/670	2-1/2"	1-1/2"	2-1/2"	S-45 2-1/2"

*Assumes 50 equivalent feet pf piping or less.

FIGURE 32

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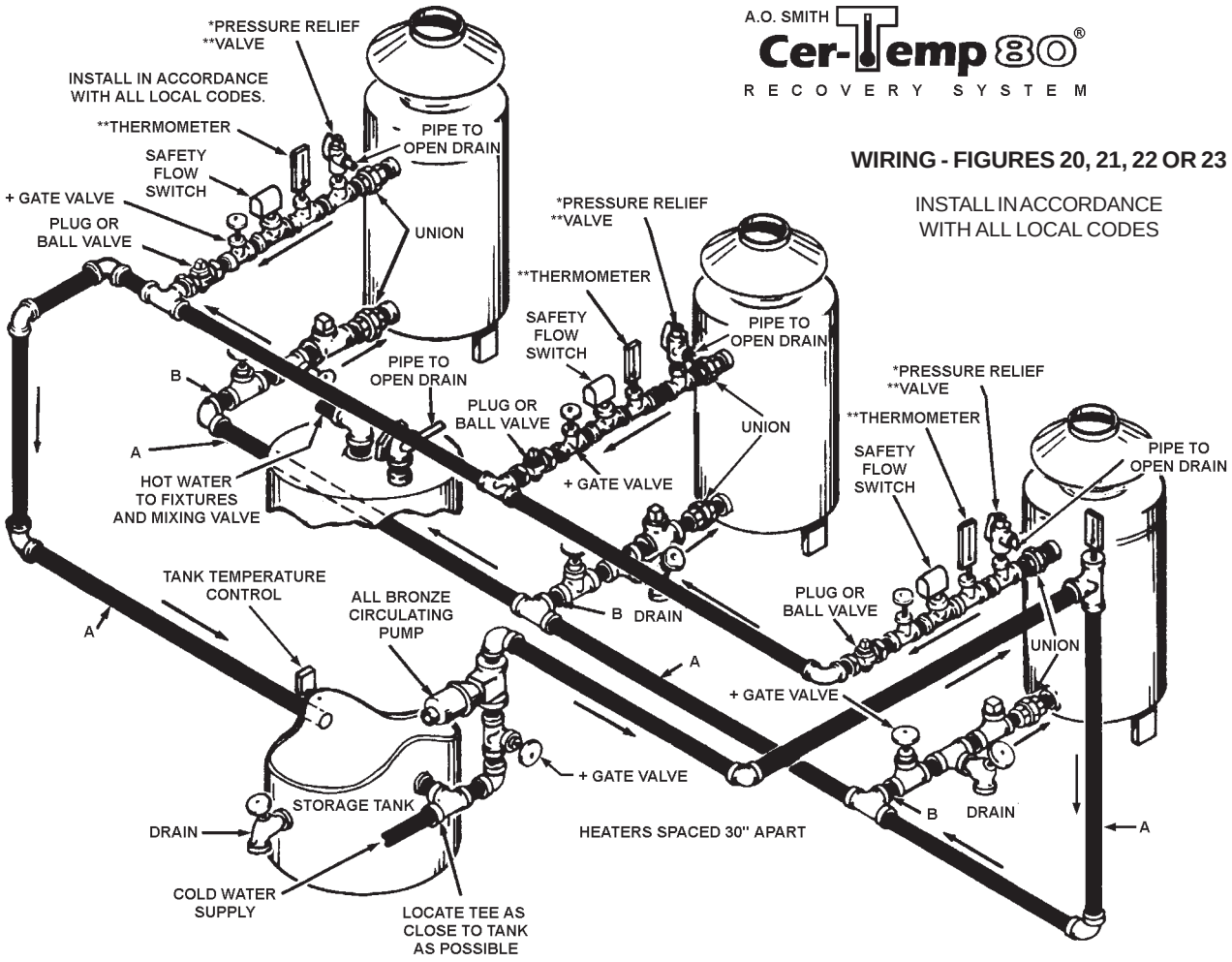
THREE HW-520's, HW-610's OR HW-670's UP-FLOW MODEL COMMERCIAL BOILER WITH VERTICAL TANK, CER-TEMP 80

A.O. SMITH Cer-Temp 80® RECOVERY SYSTEM

WIRING - FIGURES 20, 21, 22 OR 23

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES



⚠ DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 32. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

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GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

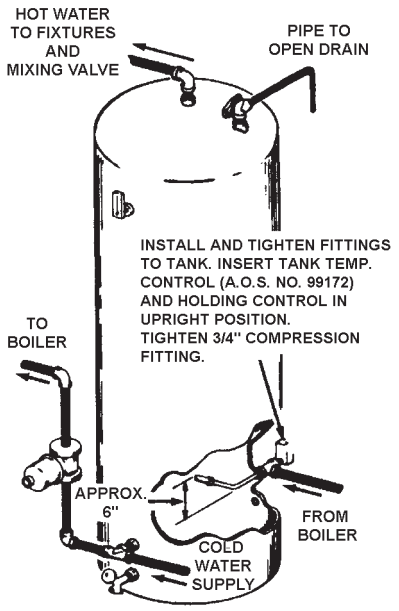
** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.

USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

Model Number	MinimumPipe Size (Inches)		B & G Pump Size	*Armstrong Pump Size
	A	B		
HW-520	2-1/2"	1-1/2"	2"	S-45 2-1/2"
HW-610/670	3"	1-1/2"	3" HD-3	S-46

*Assumes 50 equivalent feet pf piping or less.

MODIFIED VERSION USING OTHER THAN A.O. SMITH STORAGE TANK


HOT WATER TO FIXTURES AND MIXING VALVE
PIPE TO OPEN DRAIN
INSTALL AND TIGHTEN FITTINGS TO TANK. INSERT TANK TEMP. CONTROL (A.O.S. NO. 99172) AND HOLDING CONTROL IN UPRIGHT POSITION. TIGHTEN 3/4" COMPRESSION FITTING.
TO BOILER
APPROX. 6"
FROM BOILER
COLD WATER SUPPLY

IF CIRCULATING LOOP IS USED, CONNECT RETURN LINE TO DRAIN CONNECTION AT TANK.

FIGURE 33

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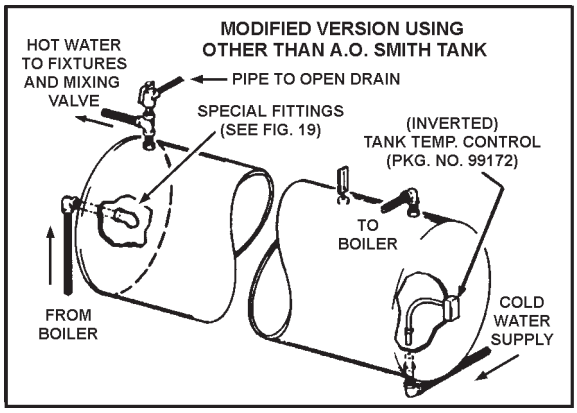
THREE HW-520's, HW-610's OR HW-670's UP-FLOW MODEL COMMERCIAL BOILER WITH HORIZONTAL TANK, CER-TEMP 80



DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 32. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

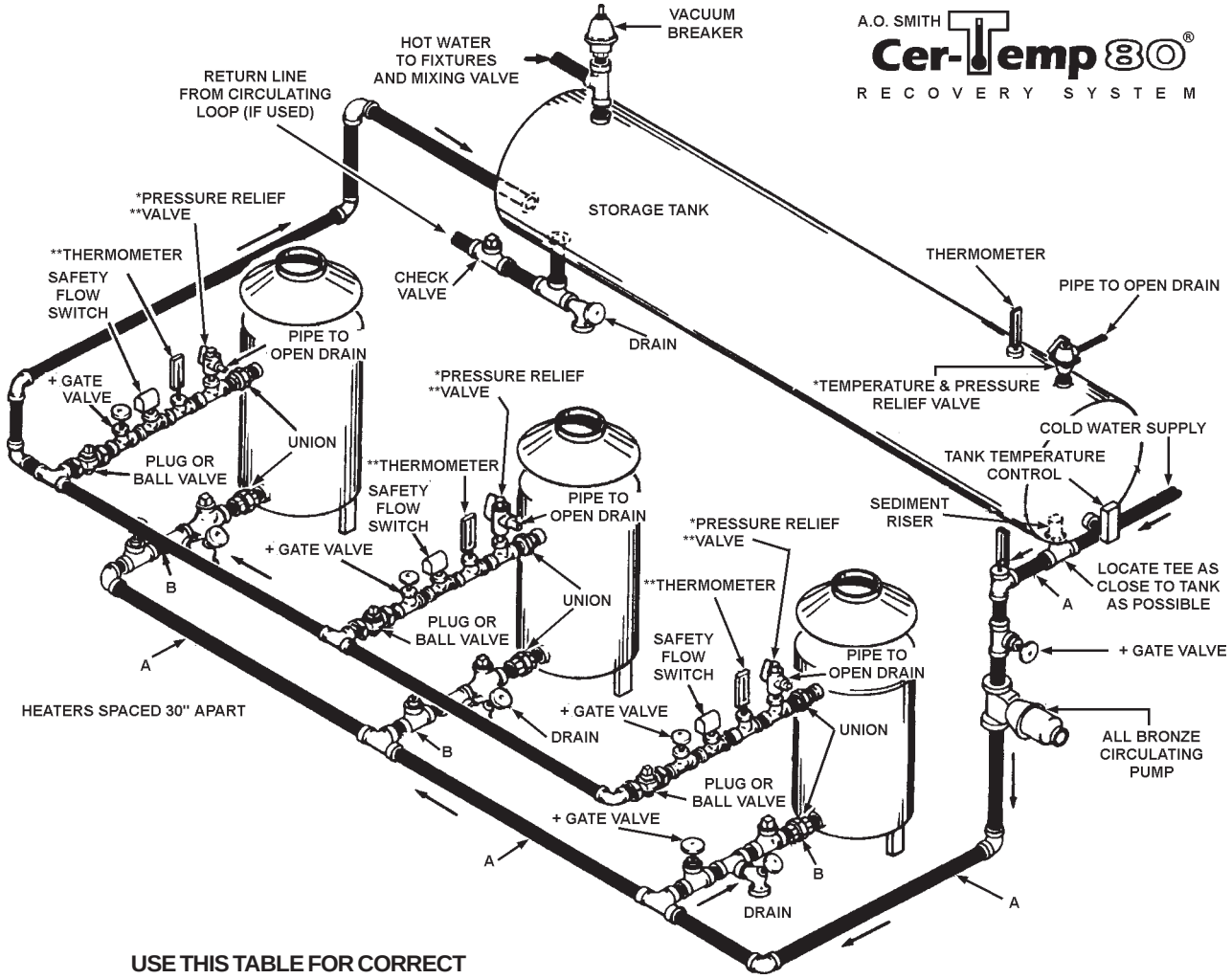
IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE
(A.O. SMITH PKG. NO. 211480).

\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.



USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

Model Number	MinimumPipe Size (Inches)		B & G Pump Size	*Armstrong Pump Size
	A	B		
HW-520	2-1/2"	1-1/2"	2"	S-45 2-1/2"
HW-610/670	3"	1-1/2"	3" HD-3	S-46

*Assumes 50 equivalent feet pf piping or less.

WIRING - FIGURES 20, 21, 22, OR 23

HEATERS SPACED 24" APART

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

FIGURE 34

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BOOSTER RECOVERY SYSTEM (PATENTED)
TWO TEMPERATURE SYSTEM WITHOUT RECIRCULATION
ONE HW-300, HW-399, HW-420, HW-520, HW-610 OR HW-670 UP-FLOW MODEL
COMMERCIAL BOILER WITH VERTICAL TANK

⚠ DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 32. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

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THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE (A.O. SMITH PKG. NO. 211480).

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GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

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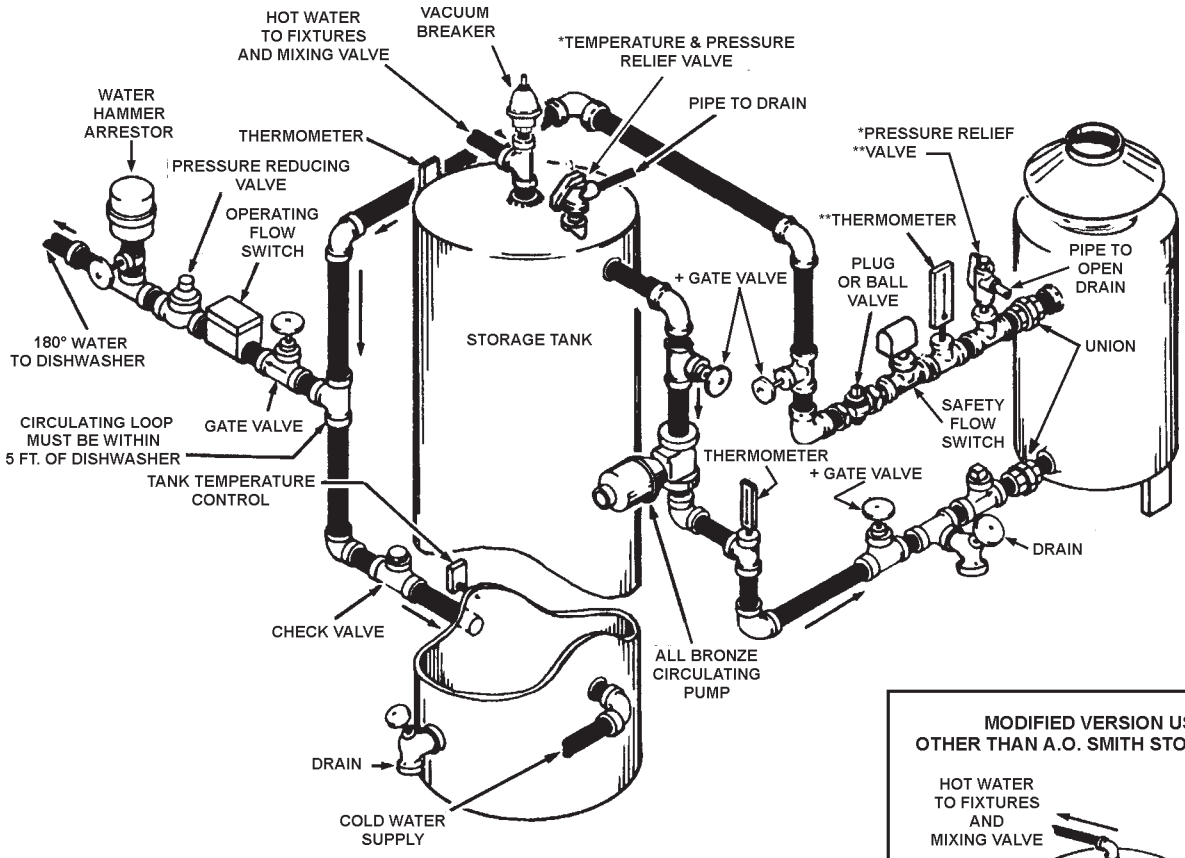
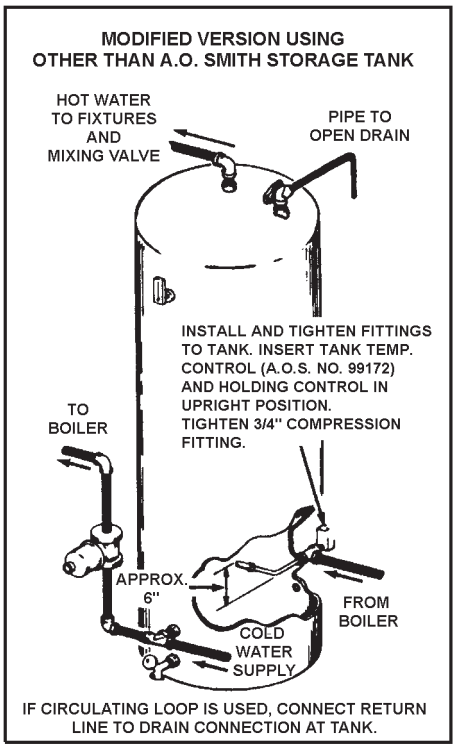
** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.




MODIFIED VERSION USING OTHER THAN A.O. SMITH STORAGE TANK
HOT WATER TO FIXTURES AND MIXING VALVE
PIPE TO OPEN DRAIN
INSTALL AND TIGHTEN FITTINGS TO TANK. INSERT TANK TEMP. CONTROL (A.O.S. NO. 99172) AND HOLDING CONTROL IN UPRIGHT POSITION. TIGHTEN 3/4" COMPRESSION FITTING.
TO BOILER
APPROX. 6"
FROM BOILER
COLD WATER SUPPLY
IF CIRCULATING LOOP IS USED, CONNECT RETURN LINE TO DRAIN CONNECTION AT TANK.

WIRING - FIGURE 25 OR 27

INSTALL IN ACCORDANCE
WITH ALL LOCAL CODES

USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

Model Number	Minimum Pipe Size (Inches)	B & G Pump Size	*Armstrong Pump Size
HW-300	1-1/4"	125	S-25 1-1/4"
HW-399	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-420	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-520	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-610/670	2"	2"	S-35

*Assumes 50 equivalent feet pf piping or less.

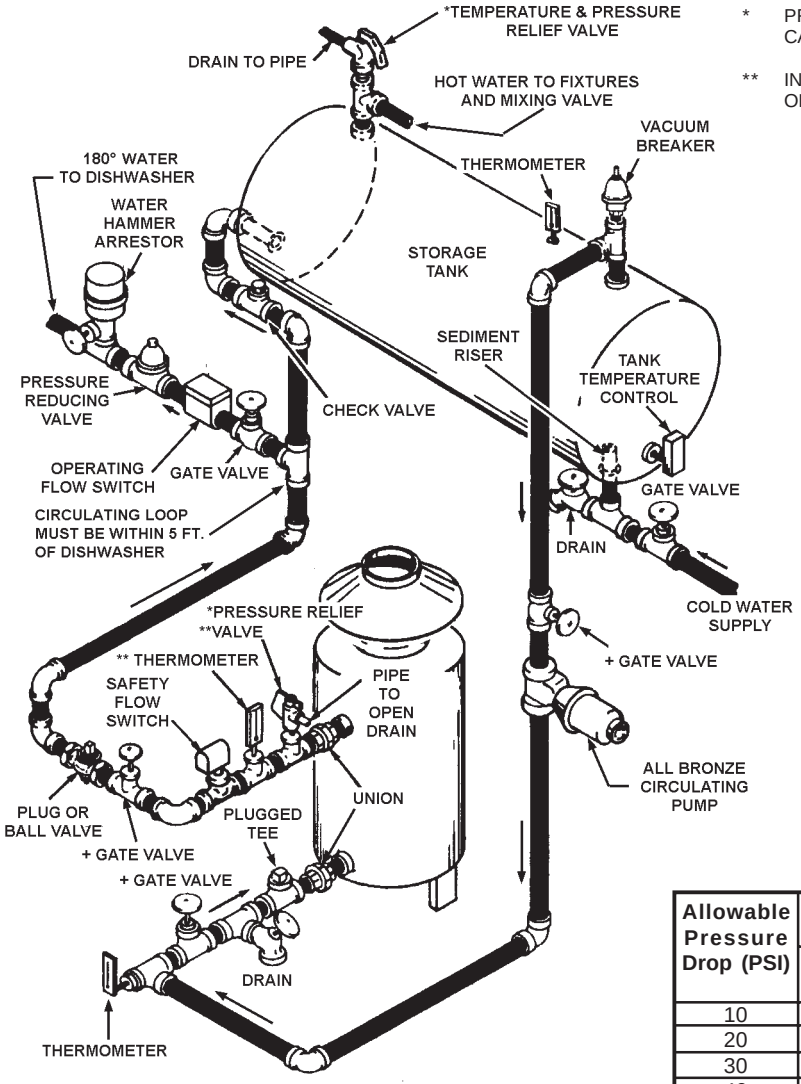
FIGURE 35

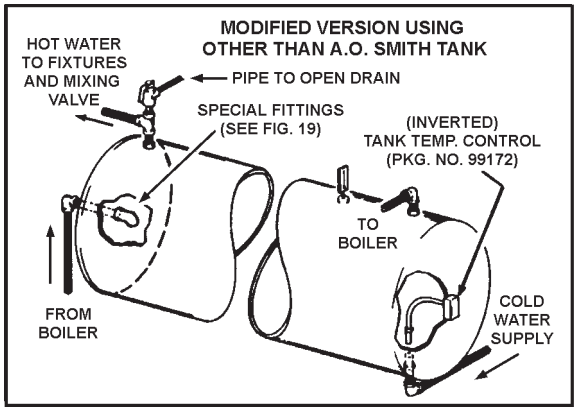
Downloaded from www.Manualslib.com manuals search engine

BOOSTER RECOVERY SYSTEM (PATENTED)
TWO TEMPERATURE SYSTEM WITHOUT RECIRCULATION
ONE HW-300, HW-399, HW-420, HW-520, HW-610 OR HW-670 UP-FLOW MODEL
COMMERCIAL BOILER WITH HORIZONTAL TANK

⚠ DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 32. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.




MODIFIED VERSION USING OTHER THAN A.O. SMITH TANK
HOT WATER TO FIXTURES AND MIXING VALVE
PIPE TO OPEN DRAIN
SPECIAL FITTINGS (SEE FIG. 19)
(INVERTED) TANK TEMP. CONTROL (PKG. NO. 99172)
TO BOILER
FROM BOILER
COLD WATER SUPPLY

IMPORTANT

THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE (A.O. SMITH PKG. NO. 211480).

\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520 & HW-610.

USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

Model Number	Minimum Pipe Size (Inches)	B & G Pump Size	*Armstrong Pump Size
HW-300	1-1/4"	125	S-25 1-1/4"
HW-399	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-420	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-520	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-610,670	2"	2"	S-35

*Assumes 50 equivalent feet pf piping or less.

WIRING - FIGURE 25 OR 27

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

PIPE SIZES "B" CIRCULATING LOOP TO DISHWASHER Type L Copper Tubing

Allowable Pressure Drop (PSI)	Distance from Heater to Dishwasher (Feet./Meters)							
	25" (7.6m)	50" (15m)	75" (22.8m)	100" (30m)	175" (53m)	200" (60m)	250" (76m)	300" (91m)
10	1/2	3/4	3/4	3/4	3/4	3/4	1	1
20	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4
30	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4
40	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4
50	1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4

FAIRLY ROUGH PIPE

Allowable Pressure Drop (PSI)	Distance from Heater to Dishwasher (Feet./Meters)							
	25" (7.6m)	50" (15m)	75" (22.8m)	100" (30m)	175" (53m)	200" (60m)	250" (76m)	300" (91m)
10	3/4	3/4	3/4	3/4	1	1	1	1
20	1/2	3/4	3/4	3/4	3/4	3/4	3/4	1
30	1/2	1/2	3/4	3/4	3/4	3/4	3/4	3/4
40	1/2	1/2	3/4	3/4	3/4	3/4	3/4	3/4
50	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4

NOTE: Allowable pressure drop is the difference in PSI between supply water pressure and the 20 PSI required at the dishwasher.

FIGURE 36

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BOOSTER RECOVERY SYSTEM (PATENTED) - TWO TEMPERATURE SYSTEM WITHOUT RECIRCULATION
ONE HW-300, HW-399, HW-420, HW-520, HW-610 OR HW-670 UP-FLOW MODEL
COMMERCIAL BOILER WITH HORIZONTAL TANK

⚠ DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 32. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

IMPORTANT

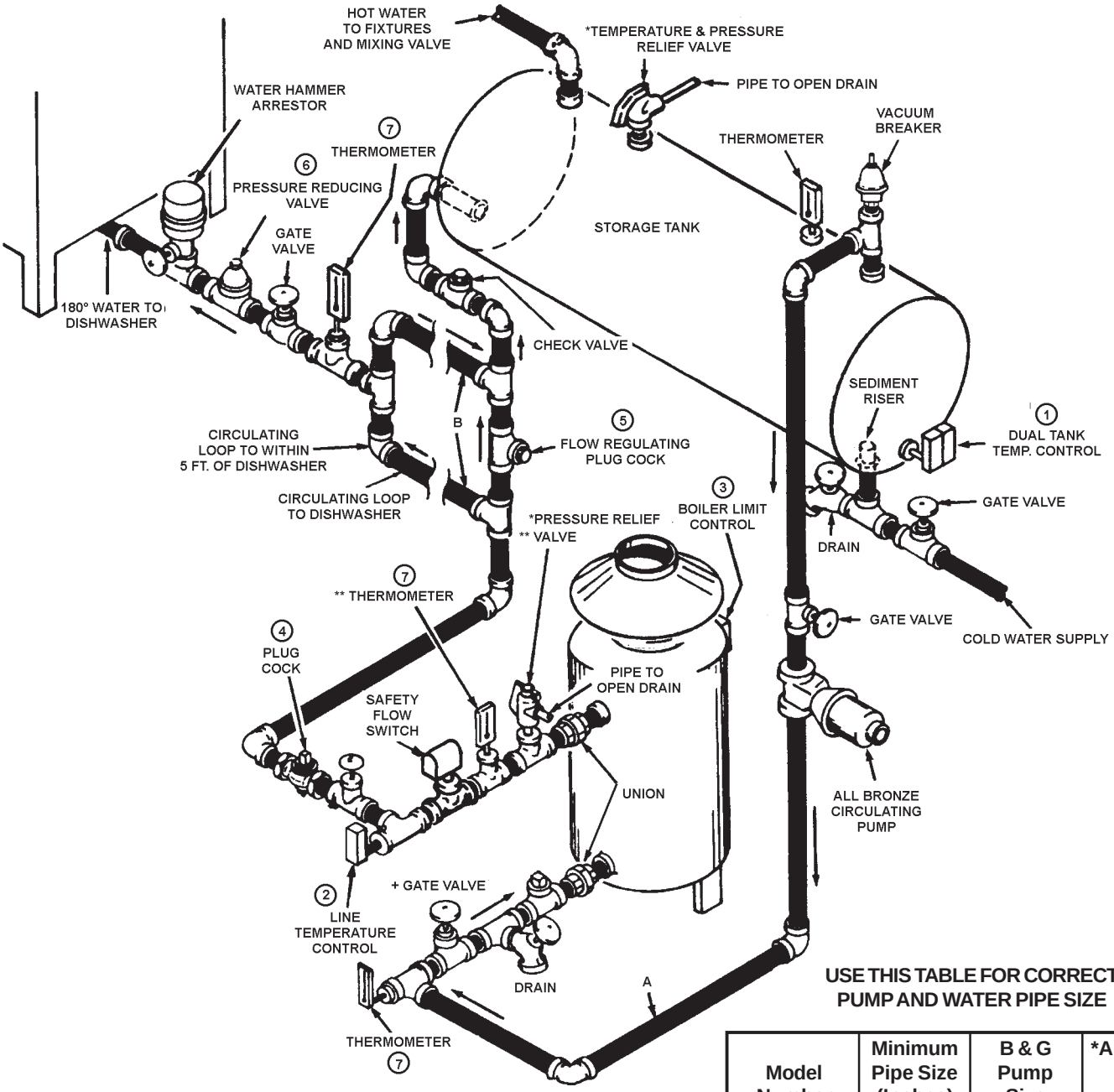
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE (A.O. SMITH PKG. NO. 211480).

\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.



WIRING - FIGURE 24 OR 26

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

USE THIS TABLE FOR CORRECT PUMP AND WATER PIPE SIZE

Model Number	Minimum Pipe Size (Inches)	B & G Pump Size	*Armstrong Pump Size
HW-300	1-1/4"	125	S-25 1-1/4"
HW-399	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-420	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-520	1-1/2"	1-1/2" HV	H-32 1-1/2"
HW-610/670	2"	2"	S-35

*Assumes 50 equivalent feet pf piping or less.

FIGURE 37

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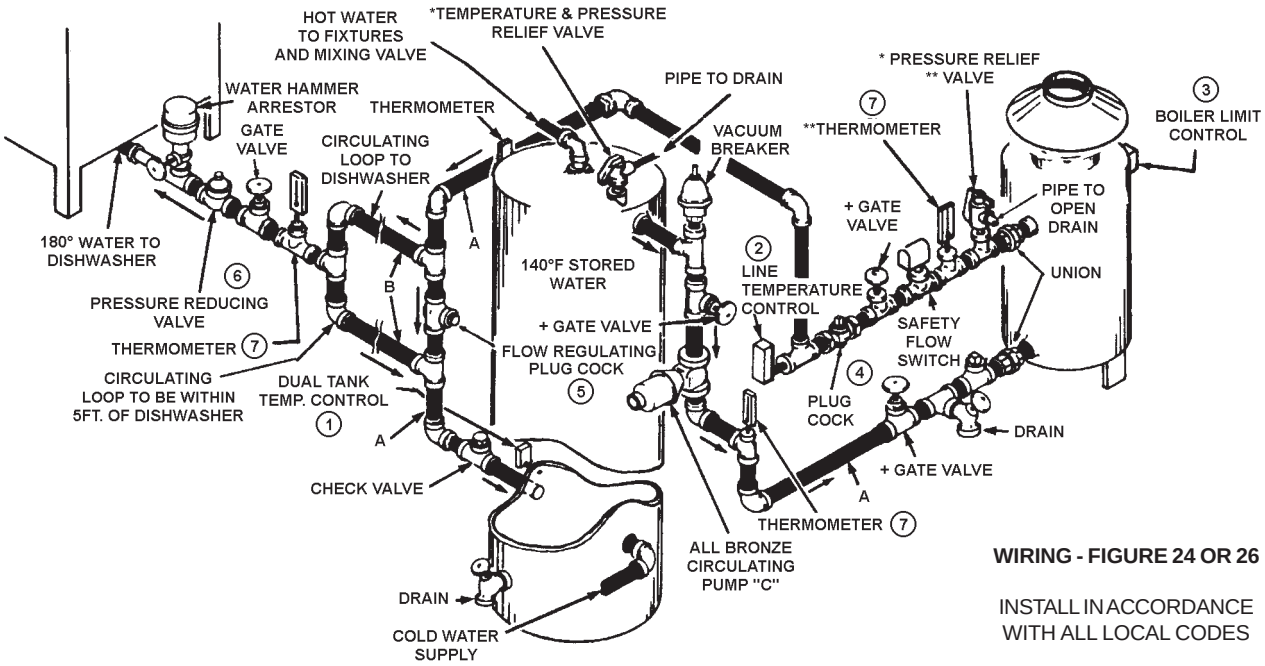
BOOSTER RECOVERY SYSTEM (PATENTED)
TWO TEMPERATURE SYSTEM WITHOUT RECIRCULATION ONE HW-300, HW-399, HW-420, HW-520,HW-610 OR HW-670
UP-FLOW MODEL COMMERCIAL BOILER WITH VERTICAL TANK



WIRING - FIGURE 24 OR 26

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES

⚠ DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 32. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

IMPORTANT
THE INSTALLATION OF SAFETY FLOW SWITCH AS SHOWN IS REQUIRED TO PROTECT THE BOILER IN CASE OF WATER SERVICE INTERRUPTION OR CIRCULATOR FAILURE (A.O. SMITH PKG. NO. 211480).

\+ PIPING AND FITTINGS BETWEEN GATE VALVES AND BOILERS SHOULD BE BRASS OR BRONZE. OTHER PIPING SHOULD CONFORM TO LOCAL CODES.

GATE VALVES ARE SHOWN FOR SERVICING BOILER. HOWEVER, LOCAL CODES SHALL GOVERN THEIR USAGE.

* PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

** INSTALL THERMOMETER AND PRESSURE RELIEF IN OPENINGS PROVIDED ON HW-520, HW-610 & HW-670.

FIGURE 38

INSTRUCTIONS FOR NUMBERED CONTROLS SHOWN ABOVE -

① DUAL TANK TEMPERATURE CONTROL

The dual tank temperature control should be installed in the lower of the two 3/4" thermostat openings in the tank.

Left Dial -High Limit
Adjust to 160°F with 20°F differential (minimum).

Right Dial -Tank Temperature
Adjust to 140°F with 8°F differential (minimum).

- May be adjusted slightly higher if total demand of 180˚F water requires higher tank temperature.

② LINE TEMPERATURE CONTROL

Install as close to boiler as possible. Do not insulate piping or tee immediately adjacent to the control.

Adjust dial to 185°F with 5°F differential (minimum).

- May be set slightly higher if radiant loss from piping prevents maintaining 180°F at dishwasher.

③ BOILER LIMIT CONTROL

(Hi Limit adjust dial 220°F with 10°F differential)

④ FLOW REGULATING PLUG COCK
(For Boiler Flow Rate Adjustment)

A slight closing of this valve may be necessary to set proper water flow rate for 40°F temperature rise through the boiler. Temperature rise is observed between the boiler inlet and outlet thermometers.

⑤ FLOW REGULATING PLUG COCK
(For Dishwasher Recirculating Loop)

Close this valve just enough to divert sufficient flow into circulating loop that will maintain 180°F at end of loop adjacent to dishwasher when dishwasher is not drawing water.

⑥ WATER PRESSURE REDUCING VALVE

Entering water pressure to the dishwasher must be set for 20 psig flow pressure. Excessive flow pressure may waste rinse water beyond the capacity of the boiler to maintain it at 180°F temperature.

⑦ INLET/OUTLET THERMOMETERS

See A. O. Smith deliming instructions Form 4778 when normal temperature rise between rinse thermometers starts to increase. Thermometers should be positioned near the inlet and outlet of the heater.

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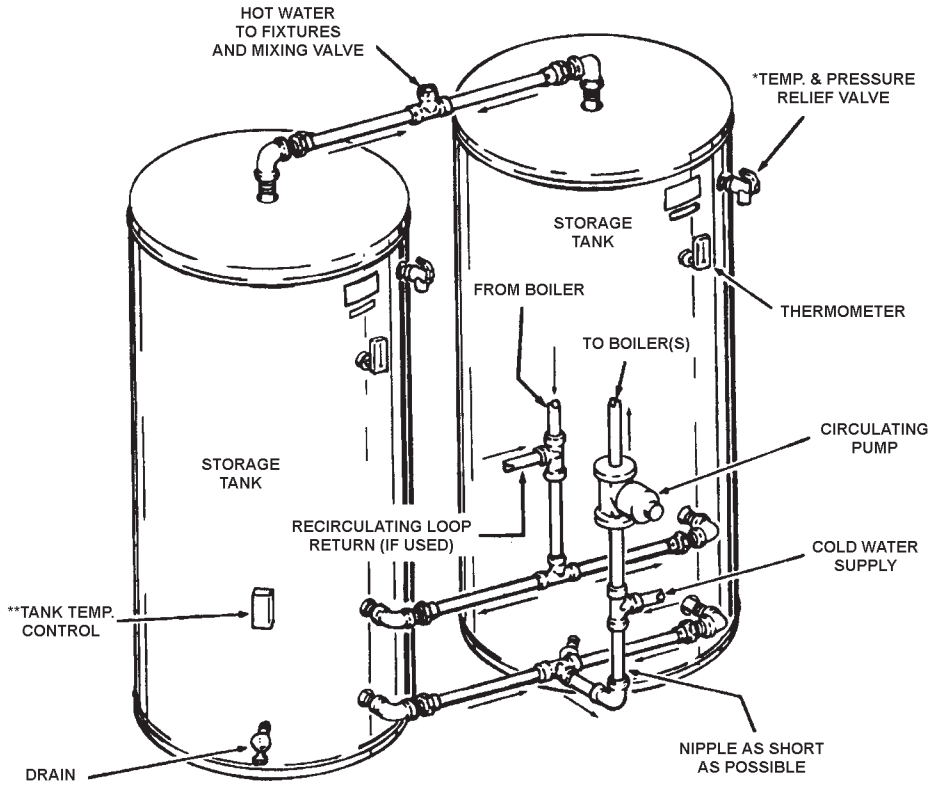
WITH TWO VERTICAL TANKS



NOTE:
CIRCULATOR AND PIPE SIZE TO BE SELECTED FROM THE CER-TEMP 80 DIAGRAM FROM THE BOILER MODEL TO BE INSTALLED.

ALL PIPING FROM TANK TO BE EQUIDISTANT TO TANKS.

INSTALL IN ACCORDANCE WITH ALL LOCAL CODES.

DO NOT INSTALL SHUT-OFF VALVES IN MANIFOLD ASSEMBLY

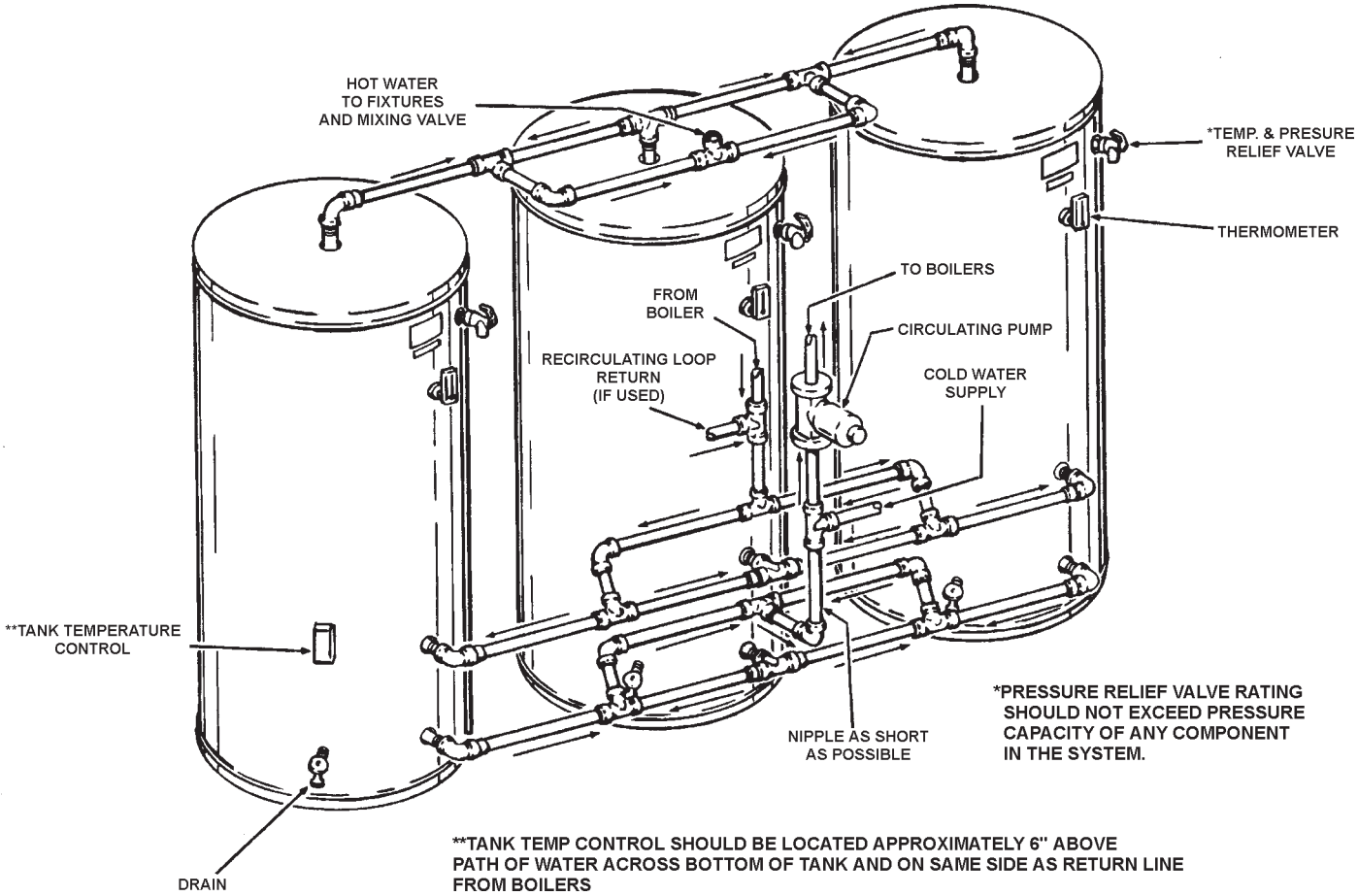
(A.O. SMITH TJV-120M STORAGE TANKS WITH PART NO. 170354-TWO TANK MANIFOLD KIT OR 170355-THREE TANK MANIFOLD KIT ILLUSTRATED).

DANGER

TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 32. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

A.O. SMITH Cer-Temp 80®
RECOVERY SYSTEM

WITH THREE VERTICAL TANKS



*PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

**TANK TEMP CONTROL SHOULD BE LOCATED APPROXIMATELY 6" ABOVE PATH OF WATER ACROSS BOTTOM OF TANK AND ON SAME SIDE AS RETURN LINE FROM BOILERS

FIGURE 39

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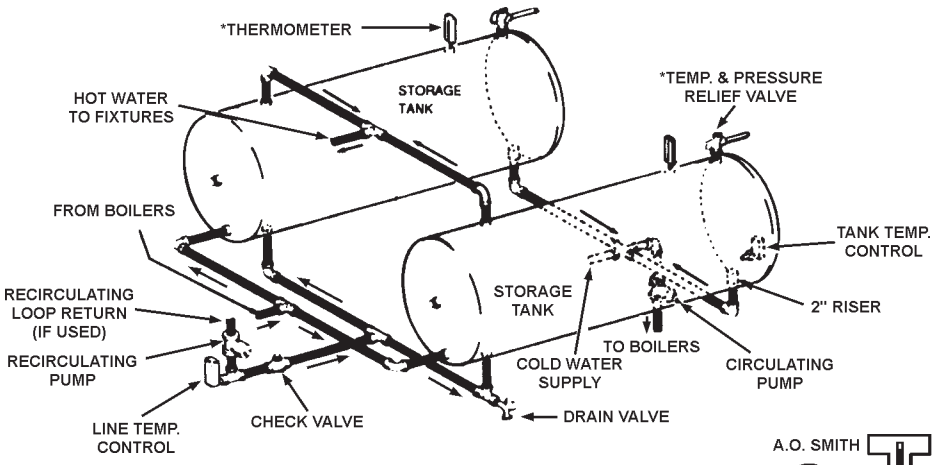
TWO HORIZONTAL TANK INSTALLATION



THREE HORIZONTAL TANK INSTALLATION

A.O. SMITH Cer-Temp 80® RECOVERY SYSTEM

⚠ DANGER

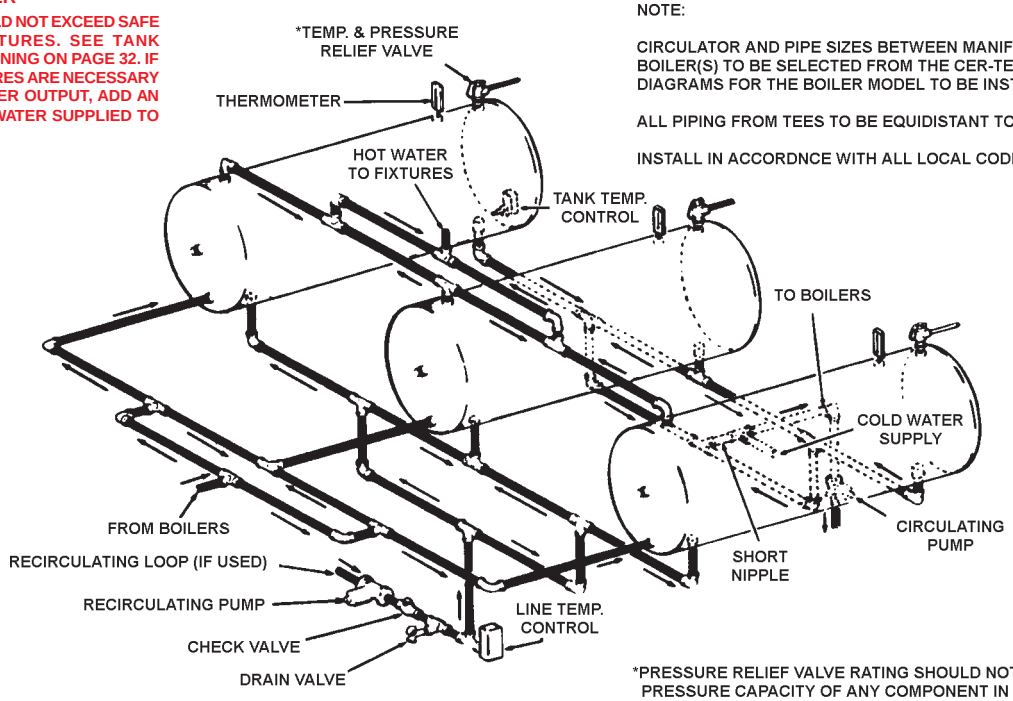
TEMPERATURE SETTING SHOULD NOT EXCEED SAFE USE TEMPERATURE AT FIXTURES. SEE TANK TEMPERATURE CONTROL WARNING ON PAGE 32. IF HIGHER PREHEAT TEMPERATURES ARE NECESSARY TO OBTAIN ADEQUATE BOOSTER OUTPUT, ADD AN ANTI-SCALD VALVE FOR HOT WATER SUPPLIED TO FIXTURES.

NOTE:

CIRCULATOR AND PIPE SIZES BETWEEN MANIFOLDS AND BOILER(S) TO BE SELECTED FROM THE CER-TEMP 80 DIAGRAMS FOR THE BOILER MODEL TO BE INSTALLED.

ALL PIPING FROM TEES TO BE EQUIDISTANT TO TANKS.

INSTALL IN ACCORDNCE WITH ALL LOCAL CODES.



*PRESSURE RELIEF VALVE RATING SHOULD NOT EXCEED PRESSURE CAPACITY OF ANY COMPONENT IN THE SYSTEM.

PIPE RELIEF VALVES TO OPEN DRAIN.

FIGURE 40

START-UP AND OPERATING INSTRUCTIONS

⚠ WARNING

After placing boiler into operation, the ignition system safety shutoff device must be tested by the following test method.

1. Reset High Limit Temperature Control to lowest setting. (See figure 38, page 44).

2. Reset System Controller to maximum setting, causing a call for heat and allowing unit to run until High Limit Temperature Control trips.

3. Resetting the High Limit Temperature Control to a higher setting, unit should run.

4. Reset System Controller and High Limit Temperature Control to desired temperature. If unit fails to run, see Trouble-Shooting in this manual.

Before operating the boiler, the entire system must be filled with water, purged of air and checked for leaks. Do not use Stop Leak or other boiler compounds. The gas piping should also be leak tested.

Any safety devices including low water cutoffs used in conjunction with this boiler should receive periodic (every six months) inspection to assure proper operation. A low water cutoff device of the float type should be flushed every six months. All relief valves should be inspected and manually operated at least twice a year.

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IMPORTANT

IT IS RECOMMENDED THAT A QUALIFIED PERSON PERFORM THE INITIAL FIRING OF THE BOILER. AT THIS TIME THE USER SHOULD NOT HESITATE TO ASK THE INDIVIDUAL ANY QUESTIONS WHICH HE MAY HAVE IN REGARD TO THE OPERATION AND MAINTENANCE OF THE UNIT.

FILLING AND VENTING

1. Fast fill system through bypass until pressure approaches desired system pressure. Close bypass valve and permit pressure to be established by the pressure reducing valve.

2. Vent all high points in system to purge system of air.

If pressure bleeding of system is desired, install valves as shown in fig. 1.

Where cast iron radiation and motorized valves are used, conventional system pressure and installation practices should be followed.

Provisions should be made to permit manual venting of radiators or convectors.

PRECAUTIONS

If the unit is exposed to the following, do not operate boiler until all corrective steps have been made by a qualified serviceman:

1. Flooding to level of burner or controls or higher.
2. Exposure to fire.
3. If damaged.
4. Firing without water.
5. Sooting

CAUTION

SHOULD OVERHEATING OCCUR OR THE GAS SUPPLY FAIL TO SHUT OFF, DO NOT TURN OFF OR DISCONNECT THE ELECTRICAL SUPPLY TO THE PUMP. INSTEAD, SHUTOFF THE GAS SUPPLY AT A LOCATION EXTERNAL TO THE APPLIANCE.

PILOT AND MAIN BURNER

To maintain safe operation and the greatest efficiency from the boiler, check the pilot and the main burner once every six months for proper flame characteristics.

1. MAIN BURNER

   The main burner, fig. 41, should display the following characteristics:

   - Provide complete combustion of gas.
   - Cause rapid ignition and carryover of flame across entire burner.
   - Give reasonably quiet operation during ignition, burning and extinction.
   - Cause no excessive lifting of flame from burner ports.

If the proceeding burner characteristics are not evident, check for accumulation of lint or other foreign material that restricts or blocks the air openings to the burner or boiler.

Also check for good flow of combustion and ventilating air to the unit. Maintain a clear area around the boiler at all times.

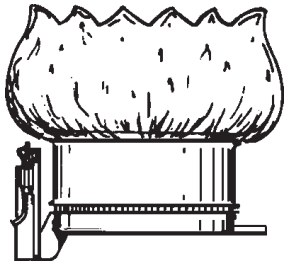

FIGURE 41

The boiler should be periodically inspected by a qualified servicer for continuous safe operation.

Qualified servicers should follow this procedure when the boiler's burners need cleaning.

1. Turn off the electrical power and close the main manual gas shutoff valve.

   - Allow boiler parts to cool before disassembly.

2. Remove main burner manifold assembly from boiler.
   - Refer to parts list supplied with this manual for disassembly aid.

3. Remove any loose foreign material such as dust or lint with a vacuum. Check all ports, orifices, and air openings for blockage. Dislodge any foreign material causing blockage. Remove any soot or carbon deposits with a rag making sure to remove any lint left on burner by vacuuming again.

4. Reinstall the burner manifold assembly on boiler.

5. Restore electrical power and gas supply to boiler.

   - Put the boiler back in operation by following the lighting instructions in this manual or on the lighting and operating label on the boiler.
   - Check for gas leaks and proper boiler and vent operation.

2. PILOT BURNER - ELECTRONIC IGNITION

   To establish pilot flame without main burner operation, it will be necessary to perform the following steps:

Servicing of the pilot burner (every six months) includes keeping pilot shield (not shown) free of lint, cleaning the burner head, the primary air opening and the orifice of the pilot burner, fig. 42.

1. Open fused disconnect switch or shut off electrical power to the boiler.

2. Turn the gas valve control knob counterclockwise to the "PILOT" position.

3. Close fused disconnect switch to restore electrical power to the boiler.

   The pilot will now ignite provided the combination gas valve knob is set at "PILOT" and the system is calling for heat.

(Continued on Page49)

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FOR YOUR SAFETY READ BEFORE OPERATING

WARNING: IF YOU DO NOT FOLLOW THESE INSTRUCTIONS EXACTLY. A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

FLAMMABLE

WARNING: HOT WATER CAN PRODUCE 3rd DEGREE BURNS IN 6 SECONDS AT 140° F. (60° C).

IN CASE OF POWER FAILURE DO NOT ATTEMPT TO OPERATE APPLIANCE. IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE CAN CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE. REFER TO THE USER'S INFORMATION MANUAL PROVIDED WITH THIS APPLIANCE. INSTALLATION AND SERVICE MUST BE PERFORMED BY A QUALIFIED INSTALLER, SERVICE AGENCY OR THE GAS SUPPLIER.

A. THIS APPLIANCE IS EQUIPPED WITH AN IGNITION DEVICE WHICH AUTOMATICALLY LIGHTS THE PILOT. DO NOT TRY TO LIGHT THE PILOT BY HAND.

B. BEFORE OPERATING: SMELL ALL AROUND THE APPLIANCE AREA FOR GAS. BE SURE TO SMELL NEXT TO THE FLOOR BECAUSE SOME GAS IS HEAVIER THAN AIR AND WILL SETTLE ON THE FLOOR.

WHAT TO DO IF YOU SMELL GAS

- DO NOT TRY TO LIGHT ANY APPLIANCE.
- DO NOT TOUCH ANY ELECTRIC SWITCH; DO NOT USE ANY PHONE IN YOUR BUILDING.
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE. FOLLOW THE GAS SUPPLIER'S INSTRUCTIONS.
- IF YOU CANNOT REACH YOUR GAS SUPPLIER, CALL THE FIRE DEPARTMENT.

C. USE ONLY YOUR HAND TO PUSH IN OR TURN THE GAS CONTROL KNOB. NEVER USE TOOLS. IF THE KNOB WILL NOT PUSH IN OR TURN BY HAND, DON'T TRY TO REPAIR IT. CALL A QUALIFIED SERVICE TECHNICIAN. FORCE OR ATTEMPTED REPAIR MAY RESULT IN A FIRE OR EXPLOSION.

D. DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN UNDER WATER. IMMEDIATELY CALL A QUALIFIED SERVICE TECHNICIAN TO INSPECT THE APPLIANCE AND TO REPLACE ANY PART OF THE CONTROL SYSTEM AND ANY GAS CONTROL WHICH HAS BEEN UNDER WATER.

ROBERTSHAW® GAS CONTROL

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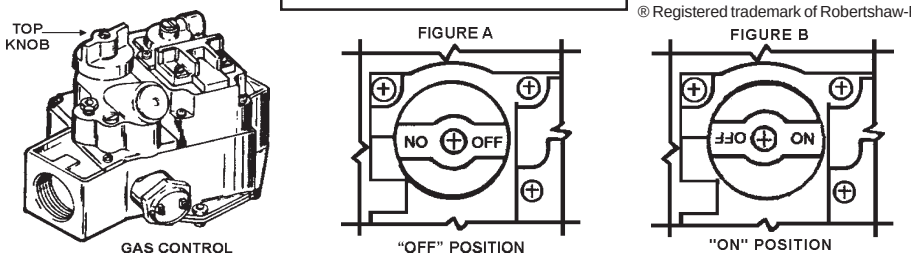

LIGHTING INSTRUCTIONS

1. STOP! READ THE SAFETY INFORMATION ABOVE.
2. MAKE SURE BOILER AND SYSTEM ARE FILLED WITH WATER AND ALL AIR HAS BEEN EXPELLED FROM APPLIANCE.
3. TURN OFF ELECTRIC POWER TO THE APPLIANCE. SET SYSTEM TEMPERATURE CONTROLLER TO LOWEST SETTING. PURGE ALL GAS LINES OF AIR.
4. DO NOT ATTEMPT TO LIGHT THE PILOT BY HAND.
5. REFER TO DIAGRAMS ABOVE. TURN TOP KNOB OF GAS CONTROL CLOCKWISE ↷ TO "OFF" POSITION, (FIG. A). CLOSE FIRING AND PILOT MANUAL VALVES, CLOCKWISE ↷.
6. WAIT FIVE (5) MINUTES TO CLEAR OUT ANY GAS. THEN SMELL FOR GAS, INCLUDING NEAR THE FLOOR. IF YOU SMELL GAS, STOP! FOLLOW "B" IN THE SAFETY INFORMATION ABOVE ON THIS LABEL. IF YOU DO NOT SMELL GAS, GO THE NEXT STEP.
7. TURN TOP KNOB OF GAS CONTROL COUNTER-CLOCKWISE ↶ TO "ON" POSITION, (FIG. B). OPEN FIRING AND PILOT MANUAL VALVES, COUNTER-CLOCKWISE ↶.
8. TURN ON ALL ELECTRIC POWER TO THE APPLIANCE.
9. SET SYSTEM TEMPERATURE CONTROLLER TO DESIRED SETTING.
10. WHEN CONTROLLER CALLS FOR HEAT, THE CIRCULATING PUMP WILL OPERATE AND THE PILOT BURNER WILL BE SPARK IGNITED. GAS CONTROL WILL OPEN AND MAIN BURNER WILL THEN IGNITE. NOTE: IF PILOT FAILS TO IGNITE, TURN OFF APPLIANCE AND CONSULT YOUR "INSTALLATION AND USERS MANUAL" FOR ADJUSTMENTS AND TROUBLESHOOTING.
11. IF THE APPLIANCE WILL NOT OPERATE, FOLLOW THE INSTRUCTIONS "TO TURN OFF GAS TO APPLIANCE" AND CALL YOUR SERVICE TECHNICIAN OR GAS SUPPLIER.

TO TURN OFF GAS TO APPLIANCE

A. SET THE SYSTEM CONTROLLER TO THE LOWEST SETTING.

B. TURN OFF ELECTRICAL POWER TO APPLIANCE.

C. TURN TOP KNOB OF GAS CONTROL CLOCKWISE ↷ TO "OFF" POSITION, (FIG. A). CLOSE FIRING AND PILOT MANUAL VALVES, CLOCKWISE ↶.

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FOR YOUR SAFETY READ BEFORE LIGHTING

WARNING: IF YOU DO NOT FOLLOW THESE INSTRUCTIONS EXACTLY. A FIRE OR EXPLOSION MAY RESULT CAUSING PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE.

FLAMMABLE

WARNING: HOT WATER CAN PRODUCE 3rd DEGREE BURNS IN 6 SECONDS AT 140° F. (60° C).

IN CASE OF POWER FAILURE DO NOT ATTEMPT TO OPERATE APPLIANCE. IMPROPER INSTALLATION, ADJUSTMENT, ALTERATION, SERVICE OR MAINTENANCE CAN CAUSE PROPERTY DAMAGE, PERSONAL INJURY OR LOSS OF LIFE. REFER TO THE USER'S INFORMATION MANUAL PROVIDED WITH THIS APPLIANCE. INSTALLATION AND SERVICE MUST BE PERFORMED BY A QUALIFIED INSTALLER, SERVICE AGENCY OR THE GAS SUPPLIER.

A. THIS APPLIANCE IS EQUIPPED WITH A STANDING PILOT WHICH MUST BE LIGHTED BY THE PUSH BUTTON IGNITER. WHEN LIGHTING THE PILOT, FOLLOW THESE INSTRUCTIONS EXACTLY.

B. <u>BEFORE LIGHTING:</u> SMELL ALL AROUND THE APPLIANCE AREA FOR GAS. BE SURE TO SMELL NEXT TO THE FLOOR BECAUSE SOME GAS IS HEAVIER THAN AIR AND WILL SETTLE ON THE FLOOR.

<u>WHAT TO DO IF YOU SMELL GAS</u>

- DO NOT TRY TO LIGHT ANY APPLIANCE.
- DO NOT TOUCH ANY ELECTRIC SWITCH; DO NOT USE ANY PHONE IN YOUR BUILDING.
- IMMEDIATELY CALL YOUR GAS SUPPLIER FROM A NEIGHBOR'S PHONE. FOLLOW THE GAS SUPPLIER'S INSTRUCTIONS.
- IF YOU CANNOT REACH YOUR GAS SUPPLIER, CALL THE FIRE DEPARTMENT.

C. USE ONLY YOUR HAND TO PUSH IN OR TURN THE GAS CONTROL KNOB. NEVER USE TOOLS. IF THE KNOB WILL NOT PUSH IN OR TURN BY HAND, DON'T TRY TO REPAIR IT. CALL A QUALIFIED SERVICE TECHNICIAN. FORCE OR ATTEMPTED REPAIR MAY RESULT IN A FIRE OR EXPLOSION.

D. DO NOT USE THIS APPLIANCE IF ANY PART HAS BEEN UNDER WATER. IMMEDIATELY CALL A QUALIFIED SERVICE TECHNICIAN TO INSPECT THE APPLIANCE AND TO REPLACE ANY PART OF THE CONTROL SYSTEM AND ANY GAS CONTROL WHICH HAS BEEN UNDER WATER.

ROBERTSHAW® GAS CONTROL

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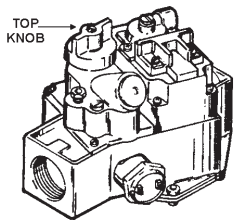

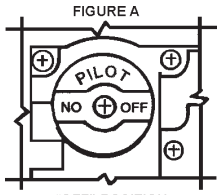

FIGURE A
"OFF" POSITION

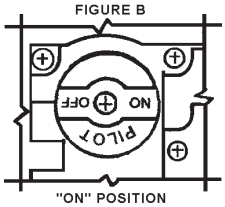

FIGURE B
"ON" POSITION

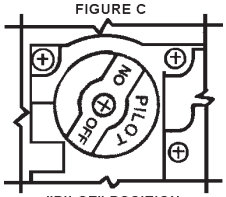

FIGURE C
"PILOT" POSITION

LIGHTING INSTRUCTIONS

1. **STOP!** READ THE SAFETY INFORMATION ABOVE .
2. MAKE SURE BOILER AND SYSTEM ARE FILLED WITH WATER AND ALL AIR HAS BEEN EXPELLED FROM APPLIANCE.
3. TURN OFF ELECTRIC POWER TO THE APPLIANCE. SET SYSTEM TEMPERATURE CONTROLLER TO LOWEST SETTING. PURGE ALL GAS LINES OF AIR.
4. REFER TO DIAGRAMS ABOVE. TURN TOP KNOB OF GAS CONTROL CLOCKWISE ↷ TO "OFF" POSITION, (FIG. A). CLOSE FIRING AND PILOT MANUAL VALVES, CLOCKWISE ↷.
5. WAIT FIVE (5) MINUTES TO CLEAR OUT ANY GAS. THEN SMELL FOR GAS, INCLUDING NEAR THE FLOOR. IF YOU SMELL GAS, **STOP!** FOLLOW "B" IN THE SAFETY INFORMATION ABOVE ON THIS LABEL. IF YOU DO NOT SMELL GAS, GO TO THE NEXT STEP.
6. PILOT CAN BE VIEWED THROUGH THE PILOT PEEP HOLE. SEE ILLUSTRATION 1.
7. OPEN FIRING AND PILOT MANUAL VALVES, COUNTER-CLOCKWISE ↶ .
8. TURN TOP KNOB OF GAS CONTROL COUNTERCLOCKWISE ↶ TO "PILOT" POSITION. (FIG. C)
9. PUSH AND HOLD TOP KNOB DOWN, THIS ALLOWS GAS TO FLOW TO PILOT.
10. DEPRESS PUSH BUTTON IGNITER, WHICH CAUSES SPARK TO JUMP ACROSS ELECTRODE, IGNITING PILOT. CONTINUE TO HOLD DOWN TOP KNOB FOR APPROXIMATELY 30 SECONDS OR UNTIL PILOT WILL CONTINUE TO STAY LIT WHEN KNOB IS RELEASED.
    - IF THE KNOB DOES NOT POP UP WHEN RELEASED, STOP AND IMMEDIATELY CALL YOUR SERVICE TECHNICIAN OR GAS SUPPLIER.
    - IF THE PILOT WILL NOT STAY LIT AFTER SEVERAL TRIES, TURN THE GAS CONTROL KNOB TO "OFF" AND CALL YOUR SERVICE TECHNICIAN OR GAS SUPPLIER.
11. OBSERVE PILOT THROUGH PEEP HOLE. ADJUST PILOT FLAME TO HEIGHT OF APPROXIMATELY 3/8" TO 1/2" (9 TO 13mm) BY MEANS OF PILOT GAS REGULATOR.
12. TURN TOP KNOB OF GAS CONTROL COUNTERCLOCKWISE TO "ON" POSITION. (FIG. B)
13. TURN ON ELECTRIC POWER AND SET SYSTEM TEMPERATURE CONTROLLER TO DESIRED OPERATING TEMPERATURE. WHEN CONTROLLER CALLS FOR HEAT, THE CIRCULATOR WILL OPERATE. GAS VALVE WILL OPEN AND MAIN BURNER WILL THEN IGNITE.
14. IF THE APPLIANCE WILL NOT OPERATE, FOLLOW THE INSTRUCTIONS "TO TURN OFF GAS APPLIANCE" AND CALL YOUR SERVICE TECHNICIAN OR GAS SUPPLIER.

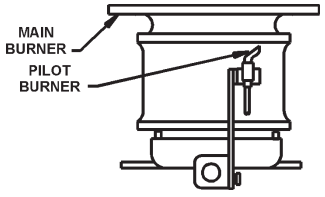

ILLUSTRATION 1

TO TURN OFF GAS TO APPLIANCE

A. SET THE SYSTEM CONTROLLER TO THE LOWEST SETTING.
B. TURN OFF ELECTRICAL POWER TO APPLIANCE.
C. TURN TOP KNOB OF GAS CONTROL CLOCKWISE ↷ TO "OFF" POSITION, (FIG. A). SEE ABOVE.
D. TURN FIRING AND PILOT MANUAL VALVES CLOCKWISE ↷ TO CLOSE POSITION.

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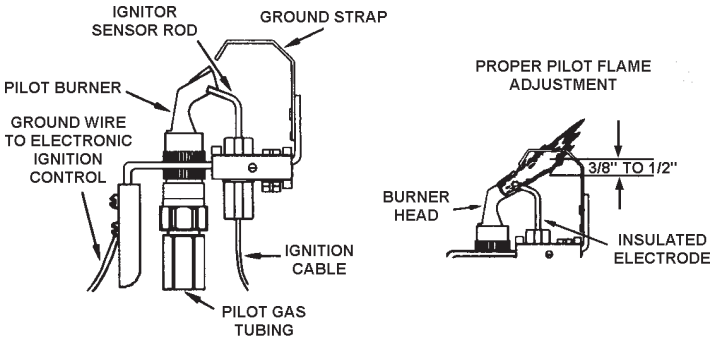
(Continued from Page 46)

4. Adjust pilot flame.

   To adjust the pilot flame, remove the cap screw from the pilot adjusting valve and turn to deliver a sufficient flame at the pilot burner to cover 3/8" to 1/2" (10-12mm) of the sensing probe tip. See fig. 42.



SPARK IGNITION PILOT BURNER **TYPICAL PILOT BURNER FLAME**

FIGURE 42

If the pilot burner ignites but the main burner fails to light, check for gas flow to the main burner.

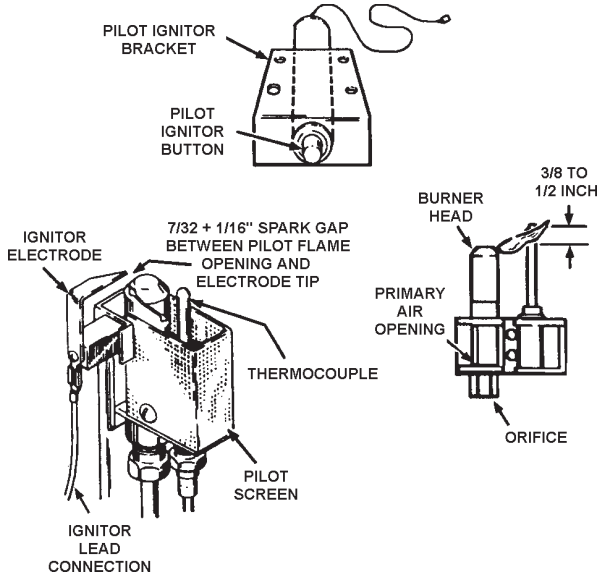
Check for good terminal connection at the sensing probe at the pilot burner assembly.

Check for electrical power to the valve. If electrical power and gas are present at the valve and the valve does not open when system calls for heat, replace valve.

3. PILOT BURNER - NON-I.I.D. MODELS

Servicing of the pilot burner (every six months) includes keeping pilot shield free of lint, cleaning the burner head, the primary air opening and the orifice pilot burner, fig. 43a.

To ensure maximum millivolt output, the pilot burner flame should envelop 3/8 to 1/2 inch of the thermocouple tip in fig. 43a. The electrical output of the thermocouple will be affected by:



PIEZO PILOT IGNITOR
FIGURE 43A

1. Low gas pressure

   - Adjust pilot flame by means of the pilot gas adjustment located in the gas valve.

- The pilot flame should envelop 3/8 to 1/2 inch of the tip of the thermocouple. Remove pilot adjustment cover screw, fig. 43b. Turn inner adjustment screw or pilot adjusting valve clockwise to decrease, or counterclockwise to increase pilot flame. Be sure to replace cover screw on combination gas valve after adjustment to prevent possible gas leakage.

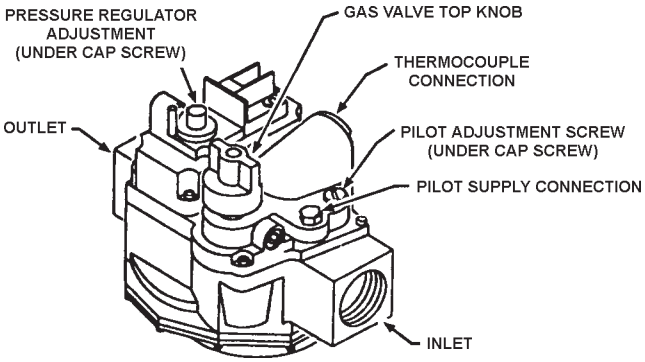


FIGURE 43B

2. Clogged pilot burner orifice.

   - Clean or replace orifice. A clogged orifice will restrict gas flow and result in low thermocouple output.

3. Incorrect orifice.

   - Replace. Orifice size is stamped on the wrench flats.

4. Clogged primary air opening.

   - Restricted air passages will soften the pilot flame and result in poor thermocouple flame impingement.

CLOSED CIRCUIT TEST

1. Attach the leads from a millivolt meter to the thermocouple and junction block as shown in fig. 43c.

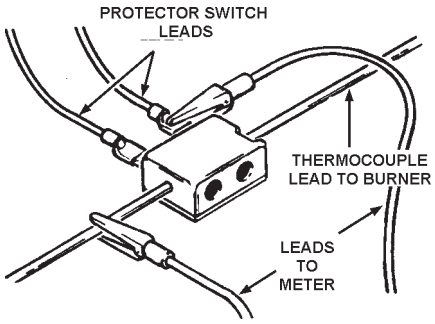


FIGURE 43C

   - A satisfactory thermocouple will produce a reading of above 14 to 18 millivolts.

2. Transfer the lead on the junction block to other terminal, figure 43d.

   - A satisfactory voltage supply through the protector switch will result in a reading of 8 to 14 millivolts.

   - If a reading of less than 8 millivolts is obtained, the junction block connections and the protector switch leads must be checked.

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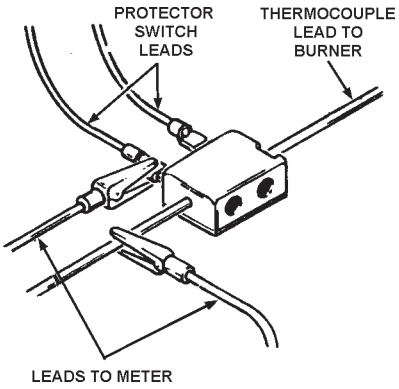

FIGURE 43D

The purpose of checking the current ahead and after the protector switch is to measure the millivolt drop across the contacts. This drop should be between 4 and 6 millivolts.

PROTECTOR SWITCH CONTINUITY TEST

Do not depress the protector switch reset button prior to testing. The leads from the switch are removed from the thermocouple function block and attached to the leads from a test flashlight.

The model N22T test kit (combination flashlight and continuity tester) is manufactured by the RAY-O-Vac Company, Madison, WI and available through local suppliers.

With the flashlight turned on, the lamp should light. If the lamp lights, the protector switch circuit is closed and in proper working order. If the lamp does not light, the reasons could be:

1. Protector switch contacts open.

- Depress reset button on switch (switch cannot be reset until water temperature in the boiler coils drop below 200°F). Lamp should light.

2. Defective protector switch or bad leads.

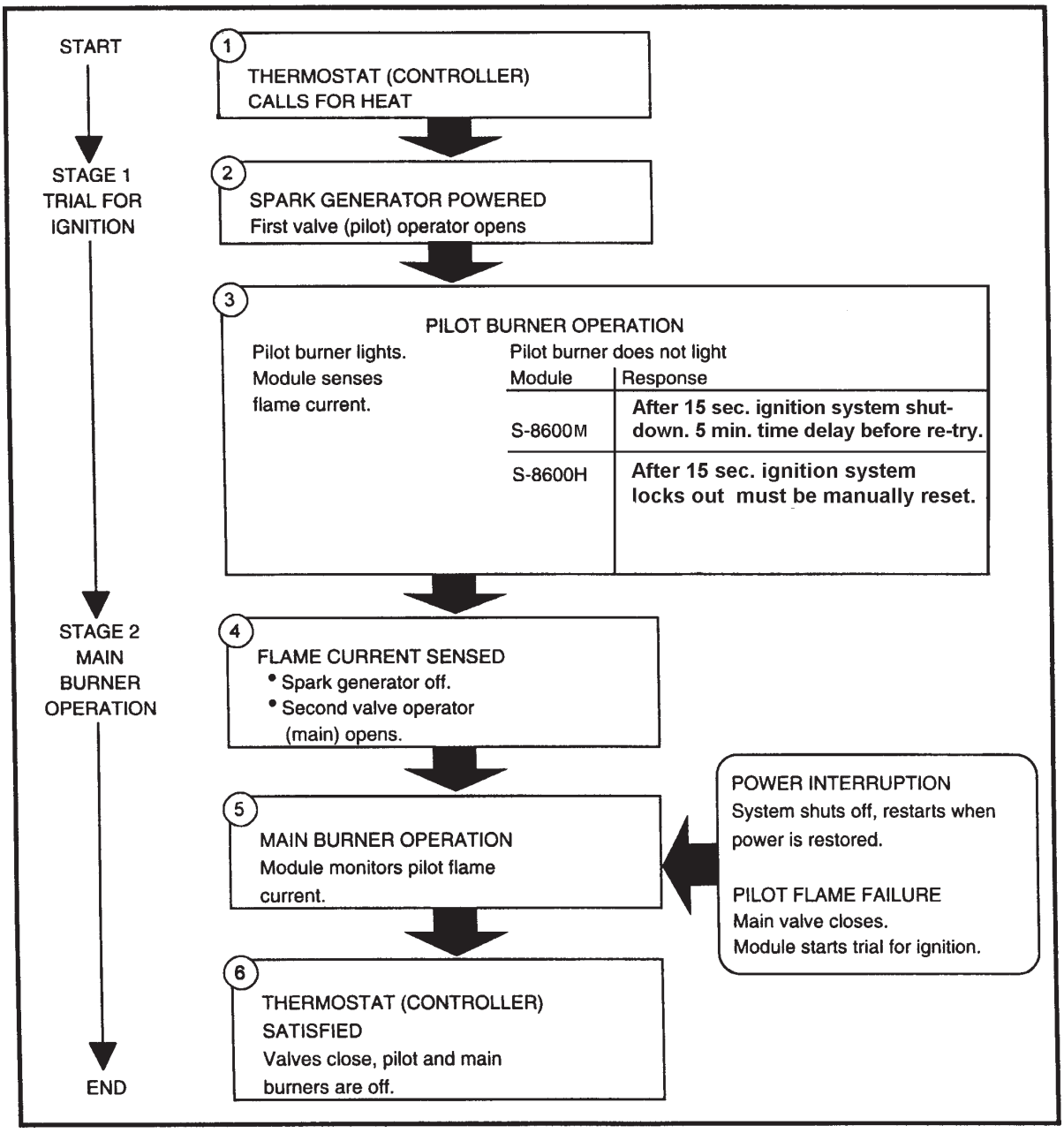

FIGURE 44

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- If lamp does not light when reset button is depressed, attach the test flashlight leads to the protector switch terminals. If lamp does not light, switch is defective and must be replaced.
- If lamp does light, the leads are bad and must be repaired or replaced.

CHECKING AND ADJUSTING THE INPUT

1. Follow steps 1 thru 6 of the OPERATING INSTRUCTIONS.
2. Attach a pressure gauge or a manometer to the manifold pressure tapping and refer to table 8 for correct manifold pressure.
3. Follow steps 7 thru 11 of the OPERATING INSTRUCTIONS.
4. Use this formula to "clock" the meter. Be sure that other gas consuming appliances are not ON during this interval.

$$\frac{3600}{T} \times H = Btuh$$

Btuh = The approximate actual input rate.

T = Time in seconds to burn one cubic foot of gas.

H = Heating value of the fuel gas in Btu per cubic foot of gas.

EXAMPLE:

T = 9.0 seconds/ft^3

H = 1050 Btu/ft^3(natural gas)

Btuh = ?

Gas flow through meter:

$$\frac{3600}{9.0} \times 1050 = 420{,}000 \text{ Btuh}$$

Small changes in the input rate may be made by adjusting the manifold pressure, see GAS PRESSURE REGULATORS. Under no circumstances should you exceed the maximum input rate for the boiler given in table 2.

5. Repeat steps 1 thru 6 of the OPERATING INSTRUCTIONS.
6. Remove the pressure gauge or manometer from the manifold pressure tapping. Replace the screw-in plug in the manifold pressure tap.
7. Repeat steps 7 thru 11 of the OPERATING INSTRUCTIONS. The boiler will resume normal operation.

When the boiler is operating at full capacity, or full gas input, it should consume 1 cu. ft. of gas in approximately the time indicated in table 10.

TABLE 10
CONSUMPTION RATE
(Refer to Operating at Full Input or Full Capacity)

Type Gas	Heating Value Btu/Ft.^3	TIME TO CONSUME 1 CU. FT. OF GAS (SECONDS)					
		HWB/ HW-300	HWB/ HW-399	HWB/ HW-420	HWB/ HW-520	HWB/ HW-610	HWB/ HW-670
Natural	1050	12.6	9.5	9.0	7.3	6.2	5.7
Propane	2500	30.0	22.6	21.4	17.3	14.8	13.4

IMPORTANT

UNDER NO CIRCUMSTANCES SHOULD THE GAS INPUT EXCEED THE INPUT SHOWN ON THE BOILER MODEL AND RATING PLATE. OVERFIRING COULD RESULT IN DAMAGE OR SOOTING OF THE BOILER. Minor variances from input on rating plate can be corrected by adjustment of gas pressure regulators described in GAS PRESSURE REGULATORS section of this manual.

The inlet gas pressure must not exceed or be less than the values shown on rating plate.

CONTROL SETTINGS

MODEL HW-300, HW-399, HW-420, HW-520, HW-610 & HW-670

The high limit is a safety device wired in series with the ignition system. Set the high limit control to approximately 10^{0}F above the maximum designed system temperature. If the boiler outlet water temperature should exceed the high limit setting, the main gas valve will close but the circulator will continue to operate. Maximum adjustable setting is 115^{0}C (239°F) cut-out with a 3^{0}C (5^{0}F) to 25^{0}C (45^{0}F) adjustable differential, fig. 45.

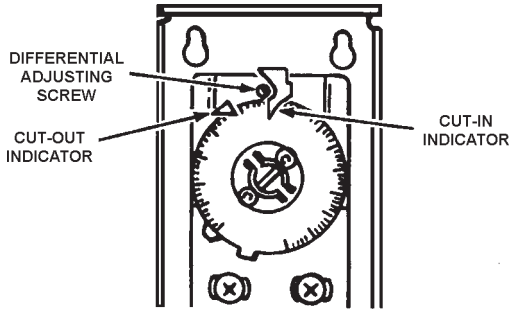

FIGURE 45

ELECTRONIC INTERMITTENT PILOT IGNITION CONTROL

The solid state ignition control, fig. 46, ignites the pilot burner gas by creating a spark at the pilot assembly. Pilot gas is ignited and burns during each running cycle. The main burner and pilot gases are cut off during the "OFF" cycle. Pilot gas ignition is proven by the pilot sensor. Main burner ignition will not occur if the pilot sensor does not first sense pilot ignition.

On models with the igniter control a spark continues to operate for 15 seconds. If pilot ignition fails, there is a 5 minute wait and retry or unit must be manually reset.

This control is non-adjustable and has no serviceable parts. The removal of its cover voids the control warranty and may damage the electronic circuit.

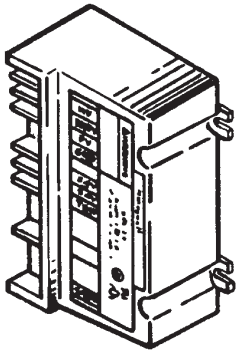

FIGURE 46

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NORMAL OPERATING SEQUENCE WITH INTERMITTENT IGNITION CONTROLS (I.I.D.)

1. System control calls for boiler operation.

2. Spark begins at pilot burner.

3. Pilot gas control valve is energized. Gas flows to pilot burner.

4. Pilot burner gas ignites. The sensing probe on the pilot burner senses the presence of the pilot flame. The spark stops after a few seconds.

NOTE: If the pilot gas isn't present or doesn't ignite after 15 seconds, the spark and pilot gas will stop, wait 5 minutes, and retry or unit must be manually reset..

5. Main gas control valve is energized and main burner gas ignites.

NOTE: If gas interruption occurs during boiler operation, the sensing probe will detect flame failure and within .8 seconds de-energize the main and pilot burner gas control valves. The operation of the control will revert back to step 2 in the foregoing.

6. System control stops boiler operation. Main and pilot burners are extinguished.

HIGH ALTITUDE INSTALLATIONS

IN CANADA

Acceptance of these models for use at altitudes above 2000 feet (600 m) is based on field test of the individual installation by the provincial/state authority having jurisdiction.

IN THE U.S.A.

WARNING

INSTALLATIONS ABOVE 2000 FEET REQUIRE REPLACEMENT OF THE BURNER ORIFICES IN ACCORDANCE WITH SECTION 8.1.2 OF THE NATIONAL FUEL GAS CODE (ANSI Z223.1). FAILURE TO REPLACE THE ORIFICES WILL RESULT IN IMPROPER AND INEFFICIENT OPERATION OF THE APPLIANCE RESULTING IN THE PRODUCTION OF INCREASED LEVELS OF CARBON MONOXIDE GAS IN EXCESS OF SAFE LIMITS WHICH COULD RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

For specific orifice requirements, please refer to the appropriate section of the National Fuel Gas Code ANSI Z223.1 or CGA 2.17-M91.

You should contact your gas supplier for any specific changes which may be required in your area.

Ratings specified by manufacturers for most boilers apply for elevations up to 2000 feet (600 m). For elevations above 2000 feet (600 m) ratings must be reduced by a rate of 4% for each 1000 feet (300 m) above sea level.

Example: If a boiler is rated at 610,000 Btu/hr. at sea level, to operate the boiler at 5000 feet (1500 m) it must be derated by 20% (4% x 5) to a new rating of 488,000 Btu/hr.

A. O. Smith does build some models specifically for high altitude service. Please check the rating plate before making changes.

The input reduction is primarily achieved by reducing the size of the main burner orifices. To do this, the main burner orifices require replacement with orifices sized for the particular installation elevation. When ordering, be sure to state the model number and the altitude of the location where the boiler is being installed.

Upon field deration of the boiler, adjustment to the gas pressure regulator is required. See CHECKING AND ADJUSTING THE INPUT in this manual for inlet and manifold pressure requirements. Also, due to the input rating reduction required at high altitudes, the output rating of the appliance is also reduced and should be compensated for in the sizing of the equipment for applications.

THERMAL BALANCER

Figure 47 shows the internal wiring of the thermal balancer. The device may be tested after disconnecting the four leads from their respective terminals on the unit.

1. Apply a test light to the yellow and red leads.
   - The lamp should light as the contact in this circuit is normally closed when the resistor is cool.

2. Apply a light to the black and yellow leads.
   - The lamp should not light as the contact in this circuit is normally open when the resistor is cool.

3. Remove the test light.

4. Apply 120 volts to the white and red leads which power the 1900 ohm resistor. After a warming period the contacts of the thermal balancer should operate.

5. Remove the test light.

6. Apply the test light as described in steps 1 and 2.

   While the resistor is still warm the lamp indications should be the opposite as described previously.

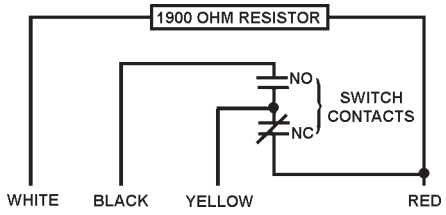

FIGURE 47

COIL HIGH LIMIT CONTROL (PROTECTOR SWITCH)

This boiler is equipped with a manual reset protector switch, located under the small cover on the side of the jacket, fig. 48. This device provides positive shutdown of the heater in the event of boiler or system malfunction. Should the surface temperature of the copper tubing heat exchanger reach 120°C (250°F), the protector switch will activate, the gas valve will close, the pilot and main burners will be extinguished. If the protector switch should shut off unit, check the following conditions:

- No water in boiler.
- Restricted water flow through the boiler.
- Improper wiring (boiler firing without circulator operating).
- Pump failure.

After correcting failure condition remove the protector switch cover and push the reset button. The protector switch may be reset after the coil surface temperature cools to .6°C (1°F).

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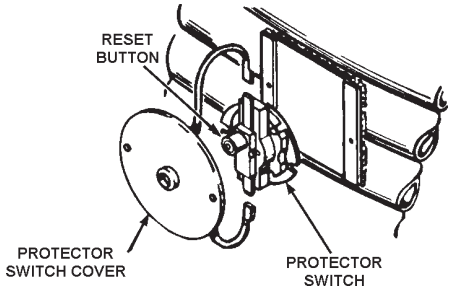


PROTECTOR SWITCH
FIGURE 48

PRESSURE REDUCING VALVE

The screen in the pressure reducing valve may require occasional cleaning due to foreign material in the water supply. This will restrict the flow and could reduce the effectiveness of purging and prolong filling time. To inspect the screen, close the main water supply valve ahead of the pressure reducing valve and remove the screen for cleaning, see fig's. 1 and 2.

SAFETY FLOW SWITCH

The safety flow switch is a safety device which must be installed at the water outlet of the unit to prevent main burner operation in the event of inadequate water flow through the unit, see fig's. 10 through 12 and 17 through 27.

An accessory package A. O. Smith No. 211480 containing a safety flow switch is available for this application.

This switch may be mounted in a horizontal pipe line or a vertical pipe line with upward water flow. Do not install the switch where the water flow is downward.

For proper performance mount the switch in a section of pipe where there is a straight run of at least 5 pipe diameters on each side of the flow switch (i.e. do not locate adjacent to valves, elbows, orifices, etc.).

The flow switch shall be mounted in a standard 1-1/2" x 1-1/2" x 1" tee for a 1-1/2" pipe application. For larger pipe sizes use a reducing tee in order to keep the switch as close to the pipe as possible. Install the flow switch in the branch (top) opening of the reducing tee and provide adequate paddle length in the flow stream. For example in a 2" pipe installation use a 2" x 2" x 1" reducing tee. For 2", or 3" pipe use paddle segments as supplied. For other pipe sizes (i.e. 1-1/4", 1-1/2" and 2-1/2") trim the paddle to the proper pipe size, see fig. 49. If a standard tee is used, install a face or hex bushing in the top opening. The paddle must be adjusted or trimmed to the size of the pipe in which it will be installed.

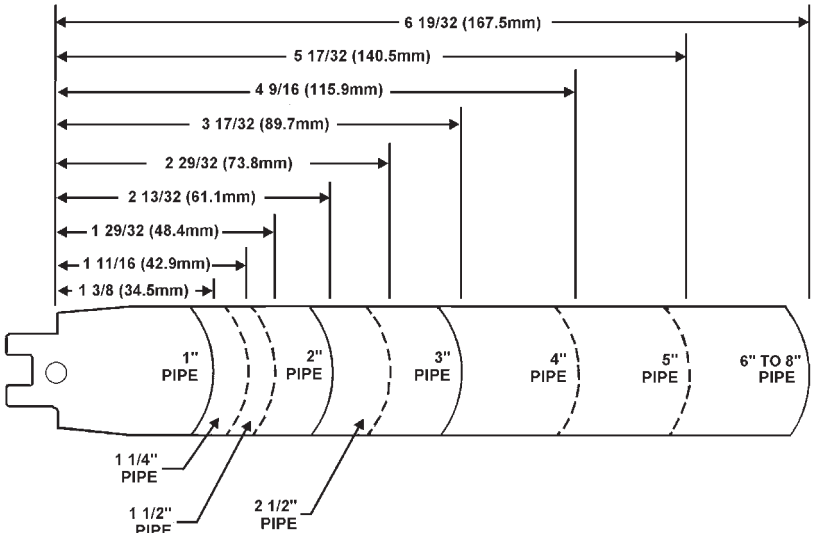
CAUTION

Any part of the paddle must not touch the pipe or any restrictions in the pipe. Screw the flow switch in position so the flat of the paddle is at right angles to the flow. The arrow on the side case must point in the direction of the flow.

TABLE 11 - SAFETY FLOW SWITCH

Model Number	Minimum Pipe Rate			
	Contacts Closed (Flow)		Contacts Open (No Flow)	
	GPM	LPS	GPM	LPS
HWB/HW-300	5.8	0.36	3.7	0.23
HWB/HW-399	7.5	0.47	5.0	0.31
HWB/HW-420	7.5	0.47	5.0	0.31
HWB/HW-520	13.7	0.86	9.5	0.60
HWB/HW-610/670	13.7	0.86	9.5	0.60

The safety flow switch may be field adjusted to obtain higher minimum flow rates than those shown in table 11.



CAUTION

Paddle must be trimmed at the dotted arc. It must not touch the pipe or have any restriction when installed

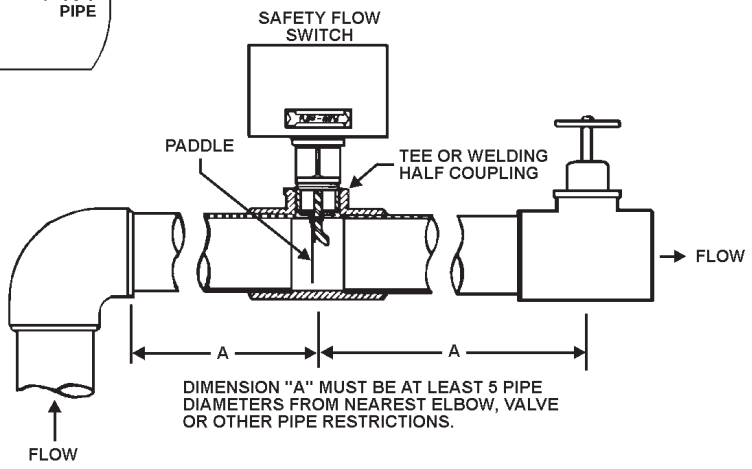


FIGURE 49

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To adjust the flow rate setting:

1. Remove the flow switch cover.
2. For higher flow rate—turn the range adjusting screw clockwise.
3. For lower flow rate—turn the range adjusting screw counter-clockwise.

CAUTION

The switch is factory set at approximately the minimum flow rate, see Table II. It must not be set lower than the factory setting as this may result in the switch failing to return at a "no flow" condition.

4. Replace the flow switch cover.

Where units are installed in multiples, each boiler must be individually protected by a safety flow switch.

SAFETY RELIEF VALVE MAINTENANCE

Every six months the system safety relief valves should be checked to ensure that they are in operating condition. To check a relief valve, lift the lever at the end of the valve several times. The valve should seat properly and operate freely.

CAUTION

BEFORE MANUALLY OPERATING A RELIEF VALVE, MAKE SURE THAT A DRAIN LINE HAS BEEN ATTACHED TO THE VALVE TO DIRECT THE DISCHARGE TO AN OPEN DRAIN. FAILURE TO TAKE THIS PRECAUTION COULD MEAN CONTACT WITH EXTREMELY HOT WATER EXITING THE VALVE DURING THIS CHECK OPERATION.

If a relief valve discharges periodically or continuously, it may be due to thermal expansion of water in a closed water supply system, or, it may be due to thermal expansion of water in a closed water supply system, or, it may be due to a faulty relief valve.

Thermal expansion is the normal response of water when it is heated. In a closed system, thermal expansion will cause the system pressure to build until the relief valve actuation pressure is equaled. Then, the relief valve will open, allowing some water to escape, slightly lowering the pressure.

A properly sized expansion tank should be installed.

ABOVE ALL, DO NOT PLUG ANY RELIEF VALVE. THIS IS NOT A SOLUTION AND CAN CREATE A HAZARDOUS SITUATION.

REPLACEMENT PARTS

U.S. Models

Replacement parts may be ordered through A. O. Smith dealers, authorized servicers or distributors. Refer to the Yellow Pages for where to call or contact the A. O. Smith Water Products Company, 5621 W. 115th Street, Alsip, IL 60803, 1-800-433-2545. When ordering parts be sure to state the quantity, part number and description of the item including **the complete model and serial number** as it appears on the product. Refer to the parts lists for more information.

Canadian Models

Replacement parts may be ordered through A. O. Smith dealers, authorized servicers or distributors. Refer to the Yellow Pages for where to call or contact the A. O. Smith Enterprises, Ltd., P. O. Box 310, 768 Erie St., Stratford, Ontario N5A 6T3, 1-800-265-8520. When ordering parts be sure to state the quantity, part number and description of the item including **the complete model and serial number** as it appears on the product. Refer to the parts lists for more information.

ProductPreservers®

QUALITY REPLACEMENT PARTS

REMOVAL OF EXISTING BOILER FROM A COMMON VENTING SYSTEM

At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.

Seal any unused openings in the common venting system.

Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.

Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.

Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.

Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.

After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliance to their previous condition of use.

Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CGA B149, Installation Codes. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Appendix F in the National Fuel Gas Code, ANSI Z223.1 and/or CAN/CGA B149 Installation Codes.

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GENERAL MAINTENANCE

These boilers are designed to give many years of efficient and satisfactory service when properly operated and maintained. To assure continued good performance, the following recommendations are made.

The area around the unit should be kept clean and free from lint and debris. Sweeping the floor around the boiler should be done carefully. This will reduce the dust and dirt which may enter the burner and pilot air passages, causing improper combustion and sooting.

THE FLOW OF COMBUSTION AND VENTILATION AIR TO THE BOILER MUST NOT BE OBSTRUCTED.

THE BOILER AREA MUST BE KEPT CLEAR AND FREE FROM COMBUSTIBLE MATERIALS, GASOLINE, AND OTHER FLAMMABLE VAPORS AND LIQUIDS.

Any safety devices including low water cutoffs used in conjunction with this boiler should receive periodic (every six months) inspection to assure proper operation. A low water cutoff device of the float type should be flushed every six months. All relief valves should be inspected and manually operated at least twice a year. More frequent inspections may be necessary depending on water conditions.

Periodic checks, at least twice a year, should be made for water and/or gas leaks.

More frequent inspections may be necessary depending on water conditions.

The boiler mounted gas and electrical controls have been designed to give both dependable service and long life. However, malfunction can occur, as with any piece of equipment. It is therefore recommended that all components be checked periodically by a qualified serviceman for proper operation.

RELIEF VALVE

The safety relief valve should be opened at least twice a year to check its working condition. This will aid in assuring proper pressure relief protection. Lift the lever at the top of the valve several times until the valve seats properly and operate freely.

⚠ DANGER

THE WATER PASSING OUT OF THE VALVE DURING CHECKING OPERATION MAY BE EXTREMELY HOT. BEFORE OPERATING RELIEF VALVE MAKE SURE DRAIN LINE IS INSTALLED TO DIRECT DISCHARGE TO A SAFE LOCATION SUCH AS AN OPEN DRAIN, TO AVOID SCALDING OR WATER DAMAGE.

⚠ WARNING

SHOULD OVERHEATING OCCUR OR THE GAS SUPPLY FAIL TO SHUT OFF, TURN THE MANUAL GAS CONTROL VALVE TO THE APPLIANCE.

CLEANING AND FLUSHING INSTRUCTIONS

INTERNAL CONTAMINANTS

The hydronic system must be internally cleaned and flushed after a new or replacement boiler has been installed to remove contaminants that may have accumulated during installation. This is doubly important when a replacement boiler is installed into an existing system where Stop Leak or other boiler additives have been used.

Failure to clean and flush the system can produce acid concentrations that become corrosive, cause gases to form that block water circulation or lead to formation of deposits on the boiler surfaces, any of which could result in damage to the system and circulator.

All hot water heating systems should be completely flushed with a grease removing solution to assure trouble-tree operation. Pipe joint compounds, soldering paste, grease on tubing and pipe all tend to contaminate a system.

Failure to flush contaminates from a system can cause solids to form on the inside of boiler exchangers, create excessive amounts of air and other gases to block circulation, foul various system accessories and even deteriorate circulation seals and impellers.

It is recommended that after installation, the boiler and system when filled should include the proper percentage of cleaning solution related to approximate water volume of the system. Fire and circulate for about one hour and then flush clean with fresh water. Commercial grease removing solutions are available from your distributor.

HOT WATER SUPPLY BOILERS PREVENTIVE MAINTENANCE

Some solids exist in most water supply systems. As the water is heated, these tend to drop out depositing as scale or lime. This scale is comparatively easy to remove if cleaned before the unit becomes clogged. The time between cleaning will vary depending upon water conditions and usage. A change of about 5ºF (3°C) in the normal temperature rise through the unit is usually an indication that it is time for preventive maintenance.

Figure 31 shows typical piping arrangement for gravity deliming of lime deposits.

DELIMING

The amount of calcium carbonate (lime) released from water is in direct proportion to water temperature and usage, see fig. 49. The higher the water temperature or water usage, the more lime deposits are dropped out of the water. This is the lime scale which forms in pipes, boilers and on cooking utensils.

Lime accumulation not only reduces the life of the equipment but also reduces efficiency of the boiler and increases fuel consumption.

The usage of water softening equipment greatly reduces the hardness of water. However, this equipment does not always remove all of the hardness (lime). For this reason it is recommended that a regular schedule for deliming be maintained.

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The time between cleaning will vary from two to six months depending upon water conditions and usage. A change of approximately 5°F in the normal temperature rise through the boiler is usually an indication that scale should be removed. For long life, copper or brass is recommended for all valves, pipe and fittings used between gate valves “A” and “B” and the boiler, see fig. 51.

Boiler failure due to excessive lime build-up voids the warranty.

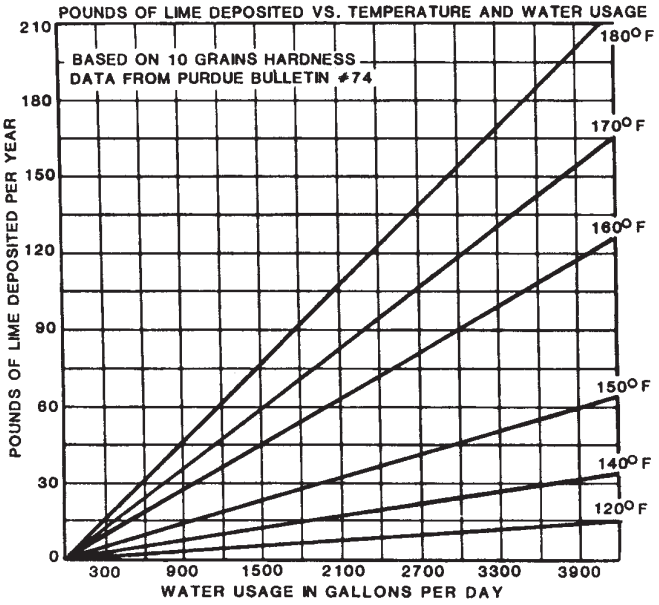


FIGURE 50

DELIMING SOLVENTS

A. O. Smith recommends the use of generic commercially available cleaning solutions to remove lime buildup from your system.

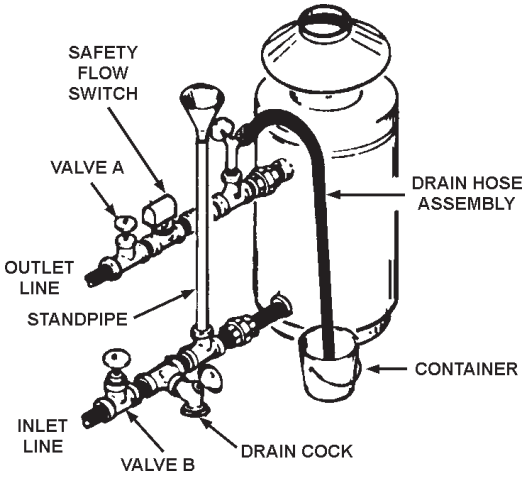
CAUTION

Read the instructions on the label of the deliming solvent container.

REMOVING LIGHT DEPOSITS OF SCALE

1. Shut off electric and gas supply to the unit.
2. Close gate valves “A” and “B”, see fig.51.
3. Open drain cock and drain unit.
4. Remove pressure relief valve from outlet header assembly and install drain hose assembly, see fig. 51.
5. Install standpipe in tee of inlet line, see fig. 51.
6. Close drain cock.
7. Slowly pour required amount of deliming solvent shown below into unit through standpipe. Direct solution into suitable container with hose, see illustration.
8. Continue to fill until foaming action stops.
9. When foaming action has stopped completely, allow 10 to 15 minutes for the solvent to dissolve any remaining scale in the unit.
10. Open the drain cock and drain all the solvent from unit.
11. Remove standpipe and drain hose assembly from tees. Install fittings originally removed into openings. Open valve “A” allowing fresh water to flow through unit and out drain cock for three to five minutes.
12. Close drain cock and open valve “B”. Restore electric and gas supply.

Check unit for proper operation.



DELIMING THE HWB/HW BOILER

FIGURE 51

MINIMUM AMOUNT OF CLEANING SOLUTION REQUIRED		
Model Number	Litres	Gallons
HWB/HW-300	12	3
HWB/HW-399	19	5
HWB/HW-420	19	5
HWB/HW-520	26	7
HWB/HW-610/670	26	7

HEAVY LIME DEPOSITS

If the solvent does not readily pass through the clogged coils or heat exchanger, it will be necessary to use an acid pump deliming kit, or contact a service agency for proper cleaning.

A. O. Smith part no. 4930 motorized deliming pump kit, complete with pump, hoses, fittings, container and instructions is available from your dealer, distributor or the A. O. Smith Water Products Company.

REMOVING SILICATE

Ammonium bifluoride flakes (NH_4F HF) can be used in conjunction with delimer to delime and remove siliceous materials from copper coil water boilers.

Ammonium bifluoride flakes should be purchased locally from chemical suppliers.

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PRE-TROUBLESHOOTING

Before any extensive trouble-shooting, perform the following:

Ensure That:

— Voltage (120 vac) is supplied to the appliance.

— System control (tank temperature control, thermostat, etc.) is calling for appliance operation (call for heat).

— Other contacts (switches) are closed (relay, low water cutoff, flow switch, coil protector, pressure switch, etc.).

— Gas supply pressure is within the maximum and minimum operating ranges listed on the appliance rating plate/label.

— Voltage (24 vac) is supplied by transformer.

— Appliance is wired according to wiring diagram.

Note: Cross wiring the 24 volt circuit of the relay will short the transformer.

— All wire terminals/connectors are firmly attached to valves, modules, switches, limit controls, etc.

— For LP models only check for possible lockout condition of the ignition module.

TROUBLESHOOTING

CER-TEMP 80 RECOVERY SYSTEM CHECKOUT PROCEDURE

Use this checkout for Cer-Temp 80 Recovery Systems. (For hot water supply application only)

	SYSTEM OPERATION			
Checkout Sequence	**Contact**	**Incorrect**	**Cause**	**Remedy**
Set tank temperature control (thermostat) 20°F (10°C) below tank water temperature	Circulating pump and burner shut off. With thermal balancer, pump off delay of approx-imately 2 minutes.	Pump and burner remain on.	Tank temperature control (thermostat) defective.	Replace.
			System wiring is incorrect.	Correct wiring.
		Circulating pump on.	Pump wired for continuous operation.	Correct wiring.
		Burner on.	Gas valve stuck or defective.	Correct or replace valve.
			System wiring is incorrect.	Correct wiring.
Set tank temperature control (thermostat) 20°F (10°C) above tank water temperature.	Circulating pump and burner on.	Circulating pump on.	High limit control set too low.	Replace. (If problem proven to be at this control by applying jumper to terminals.)
			High limit control differential too wide.	
			System wiring is incorrect.	Correct wiring.
			Coil protector switch has activated.	Remove control cover, depress reset button.
			Gas valve or wiring defective.	Check wiring. Repair or replace valve.
		Circulating pump and burner off.	Power off or system wiring is incorrect.	Check power supply and wiring.
			Tank temperature control (thermostat) defective.	Replace.
		Burner on.	System wiring is incorrect.	Correct wiring.
Boiler outlet temperature exceeds 210°F (100°C).	Circulating pump on.	Circulating pump and burner on.	High limit control defective, or set too high (max. should be set at 200°F).	Replace.
Set tank temperature control (thermostat) for desired water temperature.	System maintains. desired water temperature.			

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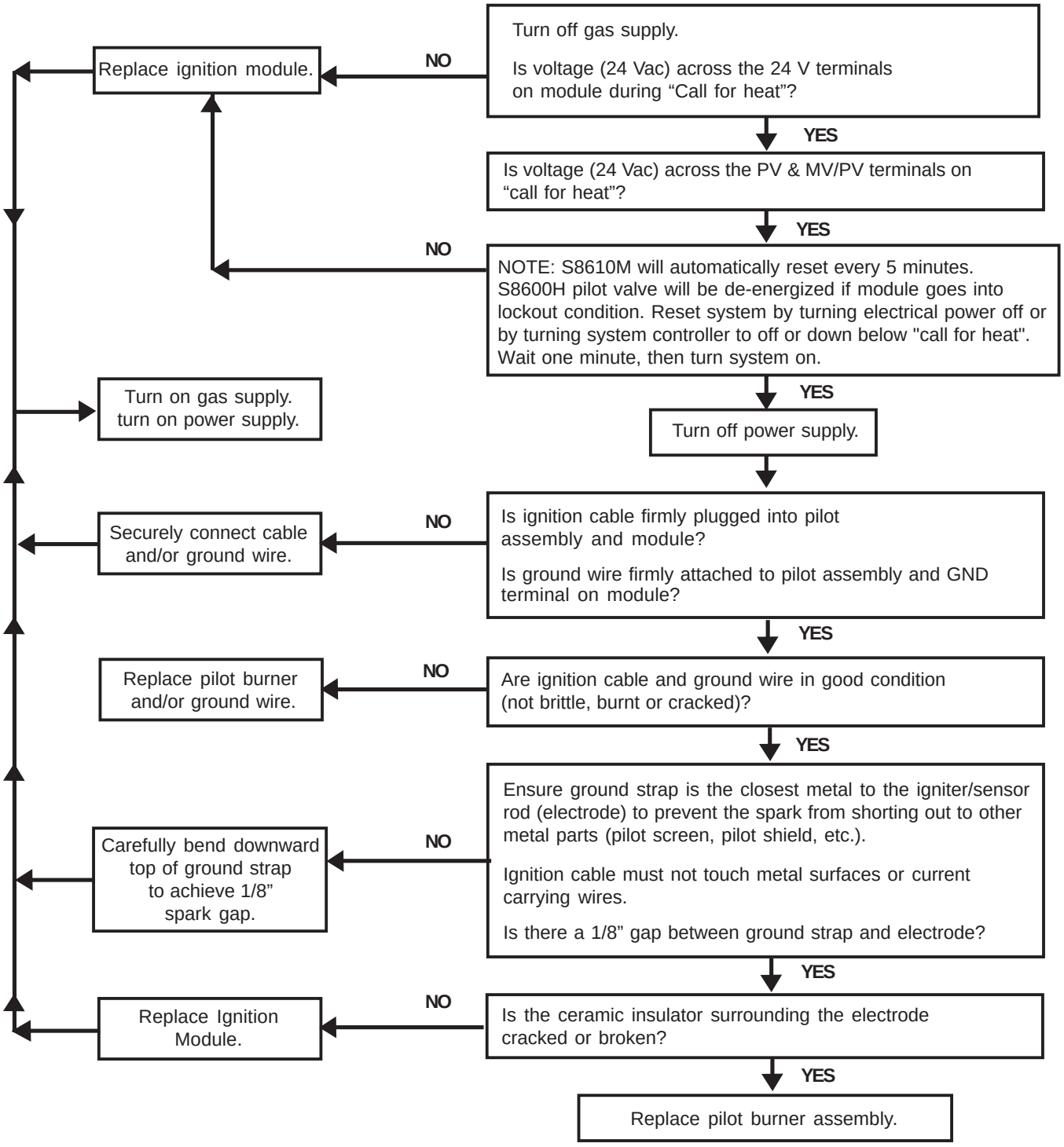
CHECKING HONEYWELL S-8600H OR S-8610M INTERMITTENT IGNITION CONTROLS

NO SPARK AT PILOT BURNER


Turn off gas supply.
Is voltage (24 Vac) across the 24 V terminals on module during “Call for heat”?
NO
Replace ignition module.
YES
Is voltage (24 Vac) across the PV & MV/PV terminals on “call for heat”?
YES
NO
NOTE: S8610M will automatically reset every 5 minutes. S8600H pilot valve will be de-energized if module goes into lockout condition. Reset system by turning electrical power off or by turning system controller to off or down below "call for heat". Wait one minute, then turn system on.
YES
Turn on gas supply. turn on power supply.
Turn off power supply.
Is ignition cable firmly plugged into pilot assembly and module?
Is ground wire firmly attached to pilot assembly and GND terminal on module?
NO
Securely connect cable and/or ground wire.
YES
Are ignition cable and ground wire in good condition (not brittle, burnt or cracked)?
NO
Replace pilot burner and/or ground wire.
YES
Ensure ground strap is the closest metal to the igniter/sensor rod (electrode) to prevent the spark from shorting out to other metal parts (pilot screen, pilot shield, etc.).
Ignition cable must not touch metal surfaces or current carrying wires.
Is there a 1/8” gap between ground strap and electrode?
NO
Carefully bend downward top of ground strap to achieve 1/8” spark gap.
YES
Is the ceramic insulator surrounding the electrode cracked or broken?
NO
Replace Ignition Module.
YES
Replace pilot burner assembly.

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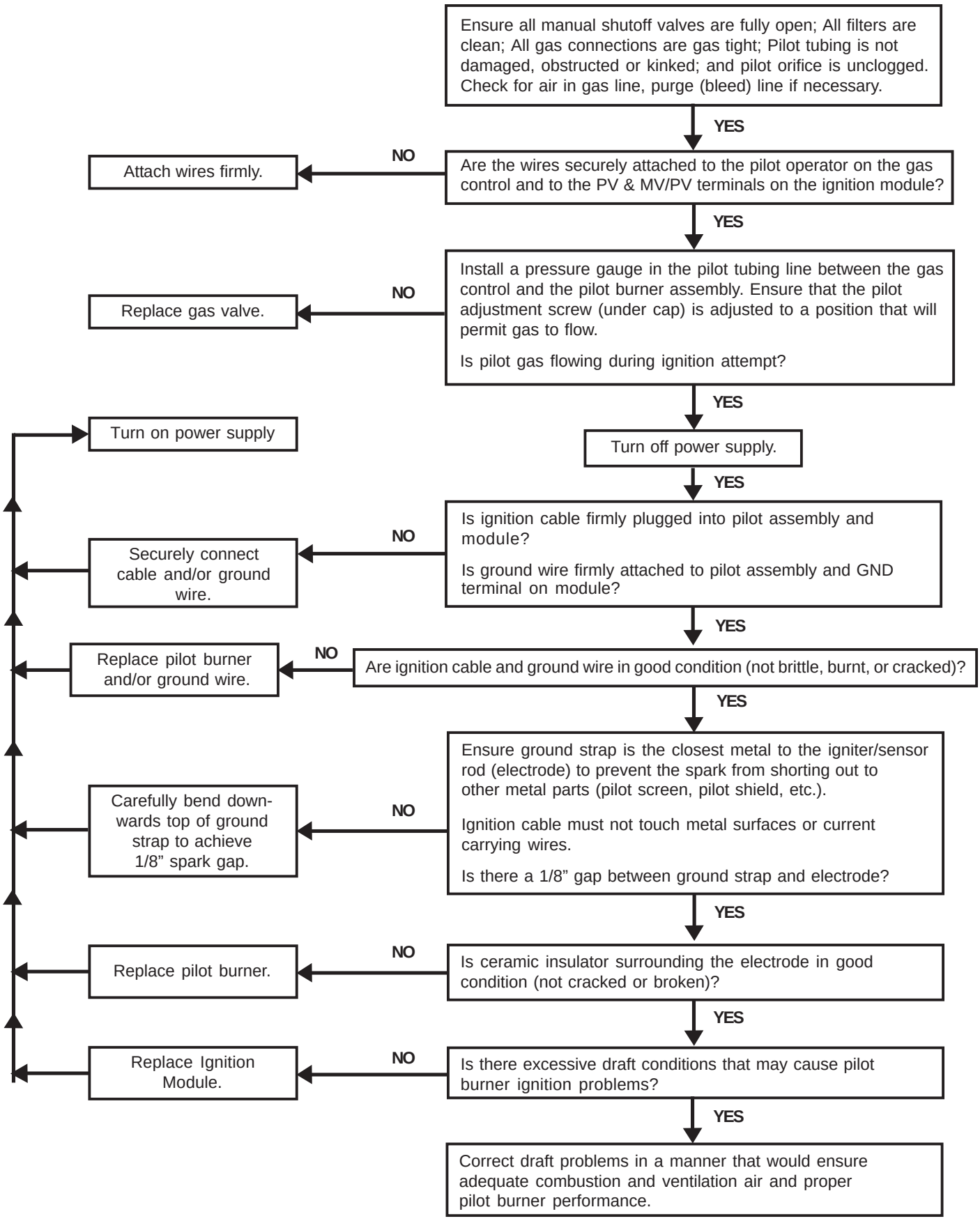
CHECKING HONEYWELL S8600H OR S-8610M INTERMITTENT IGNITION CONTROLS

SPARK AT PILOT BURNER BUT PILOT WILL NOT LIGHT


Ensure all manual shutoff valves are fully open; All filters are clean; All gas connections are gas tight; Pilot tubing is not damaged, obstructed or kinked; and pilot orifice is unclogged. Check for air in gas line, purge (bleed) line if necessary.
YES
Are the wires securely attached to the pilot operator on the gas control and to the PV & MV/PV terminals on the ignition module?
NO
Attach wires firmly.
YES
Install a pressure gauge in the pilot tubing line between the gas control and the pilot burner assembly. Ensure that the pilot adjustment screw (under cap) is adjusted to a position that will permit gas to flow.
Is pilot gas flowing during ignition attempt?
NO
Replace gas valve.
YES
Turn off power supply.
YES
Is ignition cable firmly plugged into pilot assembly and module?
Is ground wire firmly attached to pilot assembly and GND terminal on module?
NO
Securely connect cable and/or ground wire.
YES
Are ignition cable and ground wire in good condition (not brittle, burnt, or cracked)?
NO
Replace pilot burner and/or ground wire.
YES
Ensure ground strap is the closest metal to the igniter/sensor rod (electrode) to prevent the spark from shorting out to other metal parts (pilot screen, pilot shield, etc.).
Ignition cable must not touch metal surfaces or current carrying wires.
Is there a 1/8” gap between ground strap and electrode?
NO
Carefully bend downwards top of ground strap to achieve 1/8” spark gap.
YES
Is ceramic insulator surrounding the electrode in good condition (not cracked or broken)?
NO
Replace pilot burner.
YES
Is there excessive draft conditions that may cause pilot burner ignition problems?
NO
Replace Ignition Module.
YES
Correct draft problems in a manner that would ensure adequate combustion and ventilation air and proper pilot burner performance.
Turn on power supply

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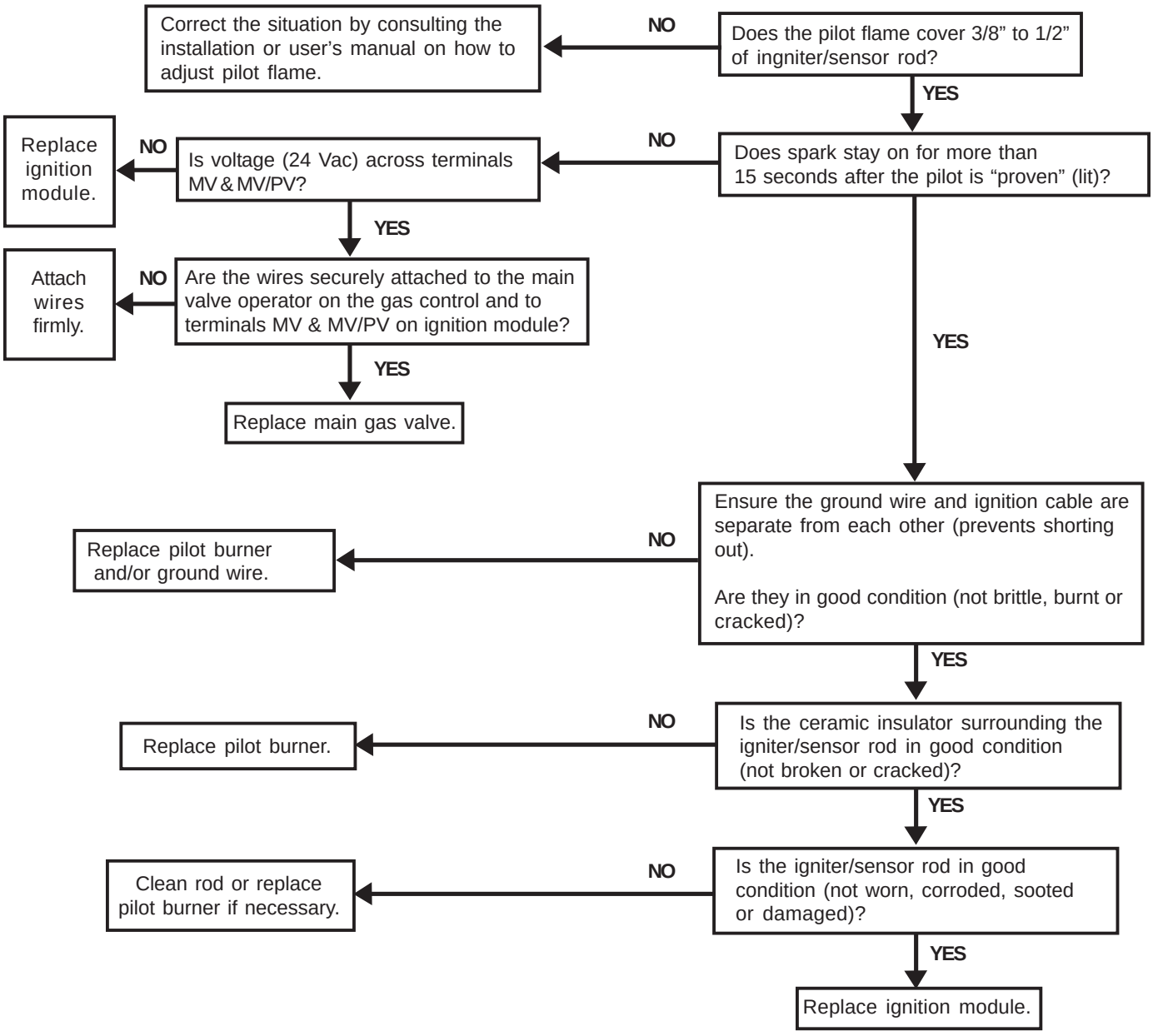
CHECKING HONEYWELL S-8600H OR S8610M INTERMITTENT IGNITION CONTROLS

PILOT BURNER LIGHTS BUT MAIN BURNER DOES NOT LIGHT


Does the pilot flame cover 3/8" to 1/2" of ingniter/sensor rod?
NO
Correct the situation by consulting the installation or user's manual on how to adjust pilot flame.
YES
Does spark stay on for more than 15 seconds after the pilot is "proven" (lit)?
NO
Is voltage (24 Vac) across terminals MV & MV/PV?
NO
Replace ignition module.
YES
Are the wires securely attached to the main valve operator on the gas control and to terminals MV & MV/PV on ignition module?
NO
Attach wires firmly.
YES
Replace main gas valve.
YES
Ensure the ground wire and ignition cable are separate from each other (prevents shorting out).
Are they in good condition (not brittle, burnt or cracked)?
NO
Replace pilot burner and/or ground wire.
YES
Is the ceramic insulator surrounding the igniter/sensor rod in good condition (not broken or cracked)?
NO
Replace pilot burner.
YES
Is the igniter/sensor rod in good condition (not worn, corroded, sooted or damaged)?
NO
Clean rod or replace pilot burner if necessary.
YES
Replace ignition module.

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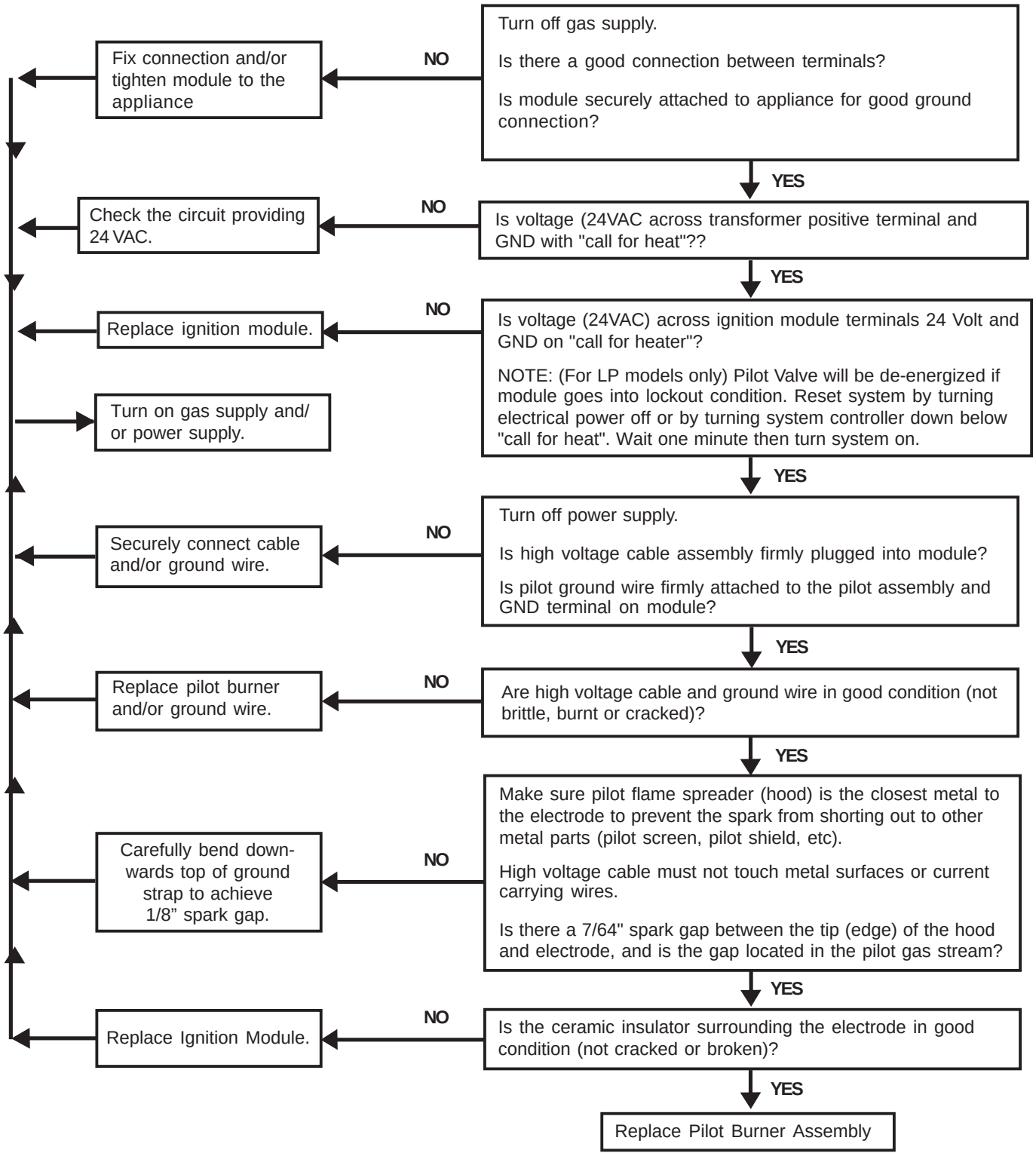
CHECKING HONEYWELL S8600H OR S-8610M INTERMITTENT IGNITION CONTROLS

NO SPARK AT PILOT BURNER BUT PILOT WILL NOT LIGHT


Turn off gas supply.
Is there a good connection between terminals?
Is module securely attached to appliance for good ground connection?
NO
Fix connection and/or tighten module to the appliance
YES
Is voltage (24VAC across transformer positive terminal and GND with "call for heat"??
NO
Check the circuit providing 24 VAC.
YES
Is voltage (24VAC) across ignition module terminals 24 Volt and GND on "call for heater"?
NOTE: (For LP models only) Pilot Valve will be de-energized if module goes into lockout condition. Reset system by turning electrical power off or by turning system controller down below "call for heat". Wait one minute then turn system on.
NO
Replace ignition module.
Turn on gas supply and/ or power supply.
YES
Turn off power supply.
Is high voltage cable assembly firmly plugged into module?
Is pilot ground wire firmly attached to the pilot assembly and GND terminal on module?
NO
Securely connect cable and/or ground wire.
YES
Are high voltage cable and ground wire in good condition (not brittle, burnt or cracked)?
NO
Replace pilot burner and/or ground wire.
YES
Make sure pilot flame spreader (hood) is the closest metal to the electrode to prevent the spark from shorting out to other metal parts (pilot screen, pilot shield, etc).
High voltage cable must not touch metal surfaces or current carrying wires.
Is there a 7/64" spark gap between the tip (edge) of the hood and electrode, and is the gap located in the pilot gas stream?
NO
Carefully bend down-wards top of ground strap to achieve 1/8” spark gap.
YES
Is the ceramic insulator surrounding the electrode in good condition (not cracked or broken)?
NO
Replace Ignition Module.
YES
Replace Pilot Burner Assembly

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LIMITED WARRANTY

A. O. Smith Corporation, the warrantor, extends the following LIMITED WARRANTY to the owner of this hydronic boiler.

1. If within TEN years after initial installation of the boiler, a heat exchanger, coil or gas burner shall prove upon examination by the warrantor to be defective in material or workmanship, the warrantor, at his option will exchange or repair such part or portion. This term is reduced to FIVE years if this boiler is used for water heating purposes other than hydronic space heating.
   a. This warranty is extended to the owner for all other parts or portion during the FIRST year following initial installation of this boiler.
   b. The warranty on the repair or replacement of the part or portion will be limited to the unexpired term of the original warranty.

3. **CONDITIONS AND EXCEPTIONS**
   This warranty shall apply only when the boiler is installed in accordance with local plumbing and building codes, ordinances and regulations, the printed instructions provided with it and good industry practices. In addition, an appropriately sized safety relief valve certified to the ASME Boiler and Pressure Vessel Code must have been installed and fresh, clean water used for filling and make-up purposes.
   a. This warranty shall apply only when the boiler is:
      (1) used at temperatures not exceeding the maximum setting of its operative and/or high limit control;
      (2) used at water pressure not exceeding the working pressure shown on the boiler;
      (3) used when filled with potable water, free to circulate at all times and with the heat exchanger(s) and coil(s) free of damaging scale deposits;
      (4) in a non-corrosive and non-contaminated atmosphere;
      (5) owned by the original purchaser;
      (6) in it's original installation location;
      (7) is sized in accordance with proper sizing techniques for commercial boilers;
      (8) bearing a rating plate which has not been altered, defaced or removed except as required by the warrantor;
      (9) fired at the factory rated input using the fuel stated on the rating plate;
      (10) maintained in accordance with the instructions printed in the manual included with the boiler;
      (11) in the United States, its territories or possessions, and Canada;
      (12) with an intermittent circulating action and with the pump and burner operating together.
      (13) in an indoor installation only.
   b. Any accident to the boiler, any misuse, abuse (including freezing) or alteration of it, any operation of it in a modified form, or any attempt to repair leaks in the coil or heat exchanger will void this warranty.

4. **SERVICE AND REPAIR EXPENSE**
   Under this limited warranty the warrantor will provide only a replacement part. The owner is responsible for all other costs. Such costs may include but are not limited to:
   a. Labor charges for service, removal, repair or reinstallation of the component part;
   b. Shipping, delivery, handling, and administrative charges for forwarding the replacement part from the nearest distributor and returning the claimed defective part to such distributor.
   c. All cost necessary or incidental for any materials and/or permits required for installation of the replacement.

5. **LIMITATION ON IMPLIED WARRANTIES**
   Implied warranties, including any warranty of merchantability imposed on the sale of this boiler under state law are limited to one (1) year duration for the boiler or any of its parts. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

6. **CLAIM PROCEDURE**
   Any claim under this warranty should be initiated with the dealer who sold the boiler, or with any other dealer handling the warrantor's products. If this is not practicable, the owner should contact:

   U. S. Customers
   A. O. Smith Corporation
   5621 West 115th Street
   Alsip, IL 60803
   Telephone: 1-800-323-2636

   Canadian Customers
   A. O. Smith Enterprises Ltd.
   P. O. Box, 310 - 768 Erie Street
   Stratford, Ontario N5A 6T3
   Telephone: 1-800-265-8520

   a. The warrantor will only honor replacement with identical or similar parts thereof which are manufactured or distributed by the warrantor.
   b. Dealer replacements are made subject to in-warranty validation by warrantor.

7. **DISCLAIMERS**
   NO OTHER EXPRESS WARRANTY HAS BEEN OR WILL BE MADE IN BEHALF OF THE WARRANTOR WITH RESPECT TO THE MERCHANTABILITY OF THE BOILER OR THE INSTALLATION, OPERATION, REPAIR OR REPLACEMENT OF THE BOILER. THE WARRANTOR SHALL NOT BE RESPONSIBLE FOR WATER DAMAGE, LOSS OF USE OF THE UNIT, INCONVENIENCE, LOSS OR DAMAGE TO PERSONAL PROPERTY, OR OTHER CONSEQUENTIAL DAMAGE. THE WARRANTOR SHALL NOT BE LIABLE BY VIRTUE OF THIS WARRANTY OR OTHERWISE FOR DAMAGE TO ANY PERSONS OR PROPERTY, WHETHER DIRECT OR INDIRECT, AND WHETHER ARISING IN CONTRACT OR TORT.
   a. Some states or provinces do not allow the exclusion or limitation of the incidental or consequential damage, so the above limitations or exclusions may not apply to you.
   b. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Fill in the following for your own reference. Keep it. Registration is not a condition of warranty. The model and serial number are found on the boiler's rating plate.

Owner _____

Installation Address _____

City and State/Province _____ Postal/Zip Code _____

Date Installed _____ Model No. _____ Serial No. _____

Dealer's Name _____ Phone No. _____

Dealer's Address _____

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REPLACEMENT PARTS

A.O. SMITH
WATER PRODUCTS COMPANY

5621 W. 115TH STREET, ALSIP, IL 60803
PHONE: 1-800-433-2545 FAX: 1-800-433-2515
E-MAIL: parts@hotwater.com • **www.hotwater.com**

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